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THIRD ANNUAL REPORT

OF THE

Agricultural Experiment Station

OF THE

UNIVERSITY OF WISCONSIN,

For the Year 1885.

MADISON, WIS:
DEMOCRAT PRINTING COMPANY, STATE PRINTERS.
1886.

☞ *The Bulletins and Reports of this Station are sent free to all residents of the State who request it.*

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LIST OF OFFICERS.

COMMITTEE OF BOARD OF REGENTS IN CHARGE OF THE STATION.

HON. HIRAM SMITH, Chairman,	SHEBOYGAN FALLS.
HON. H. D. HITT,	OAKFIELD.
HON. C. H. WILLIAMS,	BARABOO.

OFFICERS OF THE STATION.

W. A. HENRY, Agr. B.,	PROF. OF AGRICULTURE.
WM. TRELEASE, D. Sc.,	PROF. OF BOTANY AND HORTICULTURE.*
H. P. ARMSBY, Ph. D.,	PROF. OF AGRICULTURAL CHEMISTRY.
A. B. SEYMOUR, B. S.,	INSTRUCTOR IN BOTANY †

F. G. SHORT, F. W. A. WOLL, M. S.,‡	CHEMISTS.
LESLIE H. ADAMS,	FOREMAN.
WM. H. MOON,	DAIRYMAN.

Office,	16 Agricultural Hall.
Chemical Laboratory,	18 Agricultural Hall.
Botanical Laboratory,	12 Agricultural Hall.

Experimental Fields and Barn on the University Farm.

*Until July 1, 1885. †Since July 1, 1885. ‡Since September 1, 1885.

LAWS RELATIVE TO THE EXPERIMENT STATION.

Chapter 300, of the General Laws of 1883.

AN ACT to provide for an increase of income to enable the establishment of an Agricultural Station, and a chair of pharmacy and *materia medica*, at the State University, and to amend section 390 of chapter 25 of the revised statutes.

Whereas, The popular sentiment of the state strongly demands that the growing necessity for increased educational facilities for instruction in the agricultural arts shall be supplied, and that a chair of pharmacy and *materia medica* shall be established at the State University; and whereas, the income of the productive funds of that institution has diminished in consequence of the decline in rates of interest which marks the great increase in prosperity and wealth in the state, until the total income is now inadequate to its proper maintenance; therefore,

The People of the State of Wisconsin, represented in Senate and Assembly, do enact as follows:

Section 1. Section 390 of chapter 25 of the revised statutes is hereby amended so as to read as follows: Section 390. There shall be levied and collected annually a state tax of one-eighth (1-8) of one (1) mill for each dollar of the assessed valuation of the taxable property of the state, which amount when so levied and collected is appropriated to the university fund income, to be used annually as a part thereof; such increase from one-tenth (1-10) to one-eighth (1-8) of a mill on the dollar of the assessed valuation of the taxable property of the state, shall be used for the purpose of establishing, under the direction of the board of regents of the university, a chair of pharmacy and *materia medica*, and the establishment of an agricultural experiment station, and in case a surplus accrue from this increase, for the purpose aforementioned, the board of regents shall have power to dispose of the same, in the manner as of other incomes from this source, and the whole appropriation shall be deemed a full compensation for all deficiencies in said income, arising from the disposition of the lands donated to the state by congress, in trust, for the benefit of said incomes.

Section 2. This act shall take effect and be in force from and after its passage and publication.

Approved April 2, 1883.

CHAPTER 435 OF THE GENERAL LAWS OF 1885.

AN ACT to amend chapter 320, of the general laws of 1883, entitled "An act to provide for the printing and distribution of the reports of the state officers, departments and institutions."

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:

SECTION 1. Sections 7, 8 and 9, of chapter 320, of the session laws of 1883, are hereby severally amended so as to read as follows: Section 7. There shall be printed annually by the state printer, and on the order of the commissioners of public printing, the following documents:

1. Thirteen thousand copies of the transactions of the Wisconsin State Agricultural Society, together with abstracts of reports of the county and other agricultural societies, and such other matter pertaining to the industry of the state as shall be deemed important; provided the number of pages shall not exceed five hundred.

2. Sixteen thousand five hundred copies of the transactions of the Wisconsin State Horticultural Society, together with such abstracts of reports of county and other horticultural societies, and such other matters pertaining to fruit growing and other horticultural interests of the state as shall be deemed important; provided, the number of pages shall not exceed three hundred.

3. Eighteen thousand copies of the transactions of the State Dairymen's Association, and such other matters pertaining to the dairy interests of the state as shall be deemed most important; provided the number of pages shall not exceed two hundred and fifty.

4. Eighteen thousand copies of the report of the Agricultural Experiment Station of the State University; provided, the number of pages shall not exceed two hundred. Section 8. Thirteen thousand volumes of said report shall be bound in cloth, uniform in style with volumes previously published, each volume to contain such part of one copy of each of the reports designated in the preceding section as the compiler shall select, the size of said joint report not to exceed one thousand pages; and shall be distributed as follows: Thirty copies to each member of the legislature; one hundred copies to the State Historical Society; twenty-five copies to each county agricultural society and district industrial association which embraces two or more counties, and furnishes the State Agricultural Society a report of its proceedings; one hundred copies to the State Horticultural Society; thirty copies to each county horticultural society; two hundred copies to the State Dairymen's Association; one hundred copies to the experiment station of the State University; twenty-five copies to the library of the State University; five copies to the Wisconsin Humane Society. To the governor, lieutenant-governor, secretary of state, state treasurer, attorney general, state superintendent of public instruction, railroad and insurance

commissioners twenty-five copies each; to each public library in the state two copies; and the remaining copies to the State Agricultural Society for distribution by its secretary.

SECTION 9. Twenty-five hundred copies of the transactions of the State Horticultural Society shall be bound singly in cloth and one thousand in paper. Twenty-five hundred copies of the State Dairymen's Association shall be bound in cloth and twenty-five hundred in paper, Twenty-five hundred copies of the report of the Agricultural Experiment Station of the State University shall be bound in cloth and twenty-five hundred in paper for the use of these several societies and departments for distribution or exchange.

SECTION 2. All acts and parts of acts interfering with the provisions of this act are hereby repealed.

SECTION 3. This act shall take effect and be in force from and after its passage and publication.

Approved April 11, 1885.

LETTER OF TRANSMITTAL.

SHEBOYGAN FALLS, June 1, 1886.

To His Excellency, J. M. RUSK, *Governor:*

Enclosed please find the third annual report from the Experiment Station. It affords me great pleasure to transmit the same. The manifest desire expressed in all branches of agriculture throughout the state, the past year, for better and more intelligent methods of farming, brings the work of our Experiment Station more prominently to the notice and to the assistance of the most advanced cultivators, breeders and producers of the State.

Yours truly,

HIRAM SMITH,
Chairman of Farm Committee.

REPORT OF THE OFFCERS OF THE STATION.

The following report, although nominally for the year 1885, really covers approximately the period from April 1, 1885, to April 1st, 1886, and presents the results of all the completed work of the Station up to the latter date. Considerable unfinished work is now on hand and will be reported later. It is our purpose to bring our annual reports up to as late a uniform date as the requirements of the state printer will allow.

The work of the Station has gone on without interruption during the year. While there have been no striking improvements in equipment, there has been a steady and healthy increase in the facilities for thorough and accurate experimental work, and in the amount accomplished during the year, while the unproductive expenses of the Station have been steadily reduced.

Kinds of Work Undertaken — The purpose of the Station may be stated to be, in general terms, the promotion of agriculture by scientific investigation and experiment.

In pursuance of this purpose it undertakes two kinds of work:

First, it plans and executes, in field, barn and laboratory, experiments designed to increase our knowledge of the laws and conditions of plant and animal growth, and to aid in making profitable application of them in practice. It takes up such questions as the comparative value of different fodders, and their proper combination to form economical rations for various purposes; the relative value of various fertilizers for particular crops; the suitableness of new varieties of plants for our conditions; and many other similar matters which are of general interest to all farmers. Work of this sort it regards as its most important occupation, and to it it hopes to devote the larger share of its energies.

Second, in addition to work of general interest, the Station will seek to aid the individual farmer to solve questions which especially interest him. It is prepared to analyze fertilizers, fodders, milk, soils, etc.; to identify grasses, weeds, fungi (rusts, smuts, mildews, etc.), and noxious and beneficial insects; and in general to do all work proper to an experiment station, for the use and advantage of the citizens of Wisconsin.

Work of this character will be undertaken for citizens of this state free of charge on condition:

1. That samples are taken in accordance with the Station's instructions, which will be sent on application.
2. That the results are likely to be of use to the public.
3. That the Station has full liberty to publish the results obtained or otherwise use them at its discretion.

In cases where these conditions are not complied with, a moderate charge will be made. The Station, however, distinctly reserves the right to use at its discretion, for the public benefit, all results obtained by it, and in no case will enter into any privacy that can work against the public good.

Management of the Farm — There appears to be a somewhat prevalent misconception of the proper functions of a farm in connection with an experiment station. It is not infrequently expected to play the part of a "model farm," exhibiting to visitors the best attainable results in every branch of farming. Others, again, expect it to demonstrate the value of science to practice by means of an unusually favorable balance sheet, while still others look to it as an agency for the distribution of improved varieties of plants or animals. Now, while all these are worthy objects, they are not the objects which an experiment station properly so-called proposes to itself.

The business of an experiment station is to make experiments. To make experiments successfully requires not only knowledge and skill, but also that the experimenter have sufficient time to plan his experiments carefully and to supervise them constantly and effectively. This, if either numerous or elaborate experiments are to be made, is obviously incompatible with giving the requisite personal attention to the many details of the work and business management of a large farm. For this reason, no less than because a farm devoted to experiment can seldom be made profitable, we believe it to be desirable, if not essential, that the amount of ordinary farm work to be done on such a farm be made as small as possible, and the care of its business interests be made as light a burden as is compatible with the proper performance of the station's legitimate work, viz: experimenting.

In accordance with this belief, it has been and is our policy to manage the Station farm strictly as a farm for experimental purposes, and for these it is well adapted. The area of tilled land is being gradually reduced by seeding to the amount which is required for field experiments with varieties, fertilizers, tile draining, etc. The herd is being improved by sales and purchases, so that it may furnish at all times suitable animals for experiments upon milk and butter production. When the changes now in progress shall have been completed, the main portion of the farm work will consist in haying, and the care of pastures and stock, and all remaining money and energy will be devoted to experimental work. A certain amount of farm work is necessary, but the less the proportion of such work and the greater that of experimental work which a station does, the better is it fulfilling the purpose for which it was created.

In this connection it should be noted that the experimental farm is popularly regarded as something more than a plow with which to work out agricultural problems. Its beautiful location, adjoining the University grounds proper and bordering Fourth Lake, early marked it as a place of public resort. It has two miles of drives. These cut up the land irregularly, make fencing costly, and prevent much land from becoming in the least productive. We do not desire to close up the drives nor exclude the public from the grounds, but ask only that these facts be borne in mind when the expense of maintenance is considered.

Summary of Station Work.— While a considerable number of minor topics have received more or less attention, and a considerable correspondence has occupied no little time, the main work of the Station has been upon four lines of investigation, all bearing on the general subject of cattle feeding. These four lines are: 1st. The feeding value of sweet skim milk for young animals, including also studies upon the rearing of calves. 2d. The value of the corn crop as fodder and the effect upon its value of different methods of curing and feeding. 3rd. A study of the value of the oil-meals and similar fodders for milk and butter production. 4th. The relative value of corn and shorts for pork production.

It has been our policy to concentrate our efforts as far as possible upon a few important problems, and to continue the study of these from year to year until some reasonably full and certain conclusions are reached. We believe that by thus selecting a few subjects for thorough investigation the Station will in the end be of far more value to the state than if it dissipated its energies in the superficial study of any and every question which might present itself.

Thus far the lines of work indicated above, together with the necessary and proper miscellaneous work have fully employed the available resources of the Station, and promise to do so in the immediate future.

Publications — The annual report of the Station contains a full account of the work completed during the year. For the purpose of bringing important results before the public more promptly than is possible in an annual report, printed bulletins are issued from time to time. Both the report and bulletins are printed at the expense of the state. During the period covered by this report five such bulletins have been issued, aggregating fifty-five pages of the size of this report. They were: No. 5, "Analyses of Feeding-Stuffs," issued in April, 1885; No. 6, "Experiments on Calf Feeding and Analyses of Fertilizers," issued in July; No. 7, "Experiments on Calf-Feeding, and the Cooley System of Creaming Milk," issued in October; No. 8, "Oil-Meal vs. Corn-Meal for Milk," issued in December; No. 9, "Report on Oats, Potatoes and Corn for 1885," published in March, 1886.

Copies of the reports and bulletins of the Station are sent free to all residents of the state who request it, to every newspaper in the state, to every Grange in the state, to the leading agricultural papers throughout the country and to other stations and agricultural colleges in exchange. During the winter of 1885-6 a considerable number of copies was also distributed at the various farmers' institutes held throughout the state.

In addition to these means of publication, the Station has recently adopted the plan of publishing short "Newspaper Bulletins" in order to bring promptly before the public results which are of general interest, but which are not judged of sufficient importance to justify the expense of a printed bulletin. These bulletins are mailed simultaneously to every paper in the state and it is hoped that the press will aid the Station by printing them in full. They are printed by means of the cyclostyle, and as the number of copies that can be obtained is limited they, cannot be supplied to individuals. The first of these newspaper bulletins, entitled, "Analyses of Land Plaster," was issued in March, 1886, and was extensively printed by the papers of the state, and by the agricultural press generally.

By all these means, as well as by correspondence and the presence of its officers at farmers' institutes and other agricultural meetings, the Station endeavors to become acquainted with the needs of farmers, and to keep its constituents fully informed as to its work. The propriety of this course is obvious, and its good effects are seen in the increasing demand for the publications of the Station and in the rapid growth of its correspondence.

Exchanges — As just stated, the Station send its publications to other stations and agricultural colleges, boards of agriculture, etc., in exchange for theirs. It has also arranged to exchange with the leading agricultural papers of the country, and now receives regularly from the publishers and keeps on file in its office the following papers:

New England Farmer, Boston, Mass.
New England Homestead, Springfield, Mass.
Connecticut Farmer, Hartford, Conn.
Country Gentleman, Albany, N. Y.

American Dairyman, New York, N. Y.
American Agriculturist, New York, N. Y.
Husbandman, Elmira, N. Y.
American Rural Home, Rochester, N. Y.
Weekly Press, Philadelphia, Pa.
Farm Journal, Philadelphia, Pa.
American Grange Bulletin, Cincinnati, Ohio.
Farm and Fireside, Springfield, Ohio.
Field and Farm, Cincinnati, Ohio.
Indiana Farmer, Indianapolis, Ind.
Jersey Bulletin, Indianapolis, Ind.
National Live Stock Journal, Chicago, Ill.
Breeder's Gazette, Chicago, Ill.
Prairie Farmer, Chicago, Ill.
Western Rural, Chicago, Ill.
Farmer's Review, Chicago, Ill.
United States Dairyman, Chicago, Ill.
Der Deutsch-Amerikanische Müller, Chicago and N. Y.
Farmer's Advocate, St. Paul, Minn.
The Farmer, St. Paul, Minn.
Minnesota Farmer, Minneapolis and St. Paul.
Dairy and Farm Journal, West Liberty, Iowa.
Colman's Rural World, St. Louis, Mo.
Industrialist, Manhattan, Kan.
Weekly Statesman, Boise City, Idaho.
North Dakota Farmer, Jamestown, Dakota.
Pacific Rural Press, San Francisco, Cal.
Sugar Bowl, New Orleans, La.
Western Farmer, Madison, Wis.
Hoard's Dairyman, Fort Atkinson, Wis.
United States Miller, Milwaukee, Wis.

The Station also endeavors to keep as complete files as possible of the reports and bulletins of other stations, agricultural colleges, boards of agriculture, etc. At present it sends its publications to nearly sixty such institutions, including all the leading ones in the country, and receives their publications in return with more or (frequently) less regularity. It would be pleased to add to its exchange list at any time the address of any institution or society interested in agricultural investigation.

CUT VERSUS UNCUT CORNSTALKS.

By W. A. HENRY.

FIRST TRIAL.

The great value of well cured cornstalks, from which the ears have been husked, for feeding purposes, is recognized by most of our progressive farmers. With all their excellence, however, are the drawbacks that the stalks are bulky and difficult to handle, and after they are fed to stock, there remains a large amount of waste stalks in most cases which prove a great nuisance. They are troublesome to remove from mangers or in front of cows, make but the poorest of bedding, and, after getting into the stock yard or manure heap, require a whole summer before they are reduced to a condition to be handled with ease. Some farmers insist that there is a food value in the refuse stalks from which the finer parts have been eaten which is worthy of attention and saving; others insist that they are no better than so much brush.

In the second report of this Station, in reporting a trial of feeding uncut cornstalks to milch cows, it was shown that in the stalks left uneaten there was 34 per cent. of the whole weight of the fodder. It was there stated that it was proposed, during the next winter, to ascertain the value, if any, of the waste stalks. The experiments here reported are in accordance with the plan there announced.

Fodder from the same variety of corn (Pride of the North, dent) grown on the same land as that producing the fodder used in the experiment noted above was used in this trial.

The corn was cut early so as to give a fodder of good quality, and after husking, the stalks were bound into bundles and stood in large shocks until required for the experiment. Unfortunately a couple of winter rains, most unusual occurrences for the locality, at that season wet the shocks a few days before drawing the stalks into the barn. This made the fodder much heavier than it should have been.

The different lots of fodder were, however all treated alike. One lot of fodder was passed through the Lion feed cutter which not only cut the stalks into inch lengths, but ground and shredded all the coarser parts. We used this cutter since in some instances we have had the cow's mouths get sore when fed on stalks cut by a common feed cutter.

The other lot of stalks was fed in the bundle just as they came from the shock; no more of the uncut stalks being fed each day then the cows would strip clean of the leaves, husks and finer parts.

Four excellent butter cows which had recently calved, were selected for the feeding trial and divided into two lots. To one of these was given the cut, to the other the uncut stalks. Each cow, in addition to the stalks fed as described, received daily five pounds of Minneapolis bran, five pounds of corn meal and three pounds of shorts, fed dry in two feeds.

These cows stood in stanchions and were turned out for exercise but a few times during the first period as the weather was severe and stormy. During the second period they were not allowed out of the stanchions as it was designed to find how much manure they voided during this period. The manure was all carefully collected and stored by itself and will be sampled, analyzed and its value reported later. Under the conditions as stated the cows could not do so well as if they had been allowed more variety of food and exercise, and this fact should be borne in mind by the readers in studying the results.

A week's preliminary feeding preceded each trial which lasted two weeks. At the close of the first trial, the feed for the lots was reversed so that each lot of cows was on both sides of the trial two weeks and we can get the average of two trials in considering the results.

The four cows lost slightly in weight during the trials, but this should be expected from the close confinement and severe weather that prevailed during the trial. Save this loss in weight there are no unusual conditions to report, the cows all doing well.

An analysis of the fodder at the chemical laboratory shows the following:

Water	40.87 per cent.
Ash	6.86 per cent.
Protein	3.77 per cent.
Crude fiber	20.84 per cent.
Nitrogen-free extract	26.70 per cent.
Fat	.96 per cent.
Total	100.00 per cent.

Analyses of the other articles fed are given further on in the report under the heading "Analyses of Feeding Stuffs."

The following tables give the results of the two trials with cut and uncut cornstalks:

TABLE I. — CUT CORNSTALKS.

DATE OF TRIALS AND NAMES OF COWS.	Amount of cut cornstalks consumed.	Amount of bran, cornmeal and shorts consumed.	Yield of milk.		Yield of butter.	
	lbs.	*lbs.*	*lbs.*	*oz.*	*lbs.*	*oz.*
First Period, January 8–22, 14 *days.*						
Bessie and Emma	598	364	723	1	33	3
Second Period, January 29–*February* 12, 14 days.						
Doubtful and Palmer	619	364	695	8	32	9
Total	1,217	728	1,418	9	65	12

TABLE II — UNCUT CORNSTALKS.

DATE OF TRIALS AND NAMES OF COWS.	Amount of uncut cornstalks fed.	Amount of stalks left uneaten.	Amount consumed.	Amount of bran, meal and shorts fed.	Yield of milk.		Yield of butter.	
	lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*oz.*	*lbs.*	*oz.*
First Period, Jan. 8-22, 14 *days.*								
Doubtful and Palmer	929	294	635	364	758	1	35	5
Second Period, Jan. 29-*Feb.* 12, 14 *days.*								
Bessie and Emma.............	1,005	284	721	364	681	4	33	2
Total.................	1,934	578	1,356	728	1,439	5	68	7

Arranging the most important facts of the table in a direct statement, we may say, 2 cows in 4 weeks were fed 1,217 pounds cut stalks and 728 pounds of grain ration, and made 65 pounds 12 ounces of butter; 2 cows in 4 weeks were fed 1,934 pounds of uncut stalks and 728 of grain ration and made 68 pounds 7 ounces of butter.

The cows on uncut feed were fed thirty-seven per cent. more fodder than the cows on cut feed. They made four per cent. more butter, however. It will be seen by the table though, that they actually ate of the softer parts of the whole fodder 139 pounds more than the cows on cut feed.

The stalks left uneaten by the cows on uncut feed amounted to 29⅞ per cent. of the whole weight of the fodder against 34 per cent. last year.

The cows producing these results were excellent butter cows recently fresh. On the other hand they were kept as will be seen a long time on one kind of ration, and quite closely confined.

SECOND TRIAL.

In this trial the same four cows were used as in the one previously described.

The corn fodder was from a plat of 1.04 acres of Stowell's Evergreen Sweet, grown in drills, with about a third more seed used in planting than for an ordinary field crop. The results were a fair amount of fodder and a considerable number of ears and nubbins. The yield of unhusked fodder from the 1.04 acres was 11,682 pounds or 11,232 pounds per acre. The fodder was quite damp when weighed. To each lot of cows there was fed 800 pounds of cornstalks, and 160 pounds of bran. One lot of stalks with the ears on was run through the Lion feed cutter, the other was fed from the bundle. It was designated to use judgment in feeding the bran and make it last as long as the fodder did, but no longer, a few trials before beginning the experiment showing the practicability of so doing. A week's preliminary feeding preceded the first trial with each lot, but at the close of the first period the feed of the lots was reversed and the trial repeated without any intermission.

The following tables show the results of the two trials with each kind of fodder:

TABLE I—CUT FODDER CORN.

DATE, AND NAMES OF COWS.	Number of days fodder lasted.	Amount of fodder.	Amount of bran.	Yield of milk.		Yield of butter.	
	days.	*lbs.*	*lbs.*	*lbs.*	*oz.*	*lbs.*	*oz.*
First Trial, February 1st–March 4th.							
Emma and Bessie	12	800	160	475	3	21	8
Second Trial, March 4–16.							
Doubtful and Palmer	13	800	160	514	11	23	14
Total	25	1.600	320	989	14	45	6

TABLE II—UNCUT FODDER CORN.

DATE, AND NAMES OF COWS.	Number of days fodder lasted.	Amount of fodder.	Amount of waste.	Amount of bran fed.	Yield of milk.		Yield of butter.	
	days.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*oz.*	*lbs.*	*oz.*
First Period, February 21*st*–*March* 3*d.*								
Doubtful and Palmer........	11	800	79	160	472	2	22	10
Second Period, March 5–15.								
Emma and Bessie...........	11	800	64	160	400	12	18	13
Total.................	22	1,600	143	320	872	14	41	7

We find by this trial quite different results from those in the preceding one. With the uncut fodder the wetght of waste stalks is not quite nine per cent. of the amount fed, which is very small indeed.

Taking the two trials together we find the uncut fodder lasted twenty-two days against the cut fodder twenty-five days. The cows on cut stalks made three pounds fifteen ounces butter the most, but they were three days longer producing the result. The lot on uncut fodder averaged 1.88 pounds of butter per day, while the lot on cut fodder averaged slightly less, or 1.81 pounds daily.

Cutting the stalks saved one hundred and forty-three pounds of coarser parts of the fodder, but caused the cows to eat rather slower.

The results show plainly it would seem that in this case so far as saving feed was concerned, there was but a very small gain in cutting the corn fodder — not enough to pay for the labor under any circumstances.

CONCLUSIONS DRAWN FROM THE TWO TRIALS.

In the first trial where cornstalks were fed it would appear from the tables that something like 30 per cent. of the corn.

stalks were saved by cutting them, so that all were eaten. This result was with stalks of fully matured dent corn cured under ordinary conditions and from which the corn had been husked.

When we come to the second trial and have a corn grown to about ripeness but with softer and somewhat more nutritious stalks and feed this fodder, together with whatever ears or nubbins it might contain, we find a waste of less than nine per cent. with uncut fodder. The general experience is I think that when stalks and ears are fed together unhusked there is but a very small waste of stalks even with field corn; of course when sound full grown corn is fed in this way, the amount of fodder allowed each cow is small, hence she will naturally eat it closer.

With the large Southern varieties would be a still greater loss in the waste stalks than with the varity we used in the first trial. This would form one extreme and possibly Stowell's Evergreen, the other.

Whether or not then much food is saved by cutting the stalks depends largely upon the variety of corn under consideration. If one grows the large, coarse varieties, or has a large amount of stalks from dent varieties, he will get good returns from cutting, otherwise he may not. Our results seem to show, and the writer feels firm in the conviction that the showing is correct, that the only gain in cutting stalks is to get them eaten. In other words, if a cow would otherwise eat the coarser parts, there is no gain worth considering in helping her mastication with the feed cutter. I believe those with experience will assent to this, while some theorists will not.

With cornstalks valued at $4 per ton, our first trial would show that they are worth about $5.20 per ton when cut. Whether or not they can be cut for $1.20 per ton, each farmer must figure for himself, as with no two are the conditions the same. In some instances such a gain would pay handsomely. To those purchasing feed cutters, the advice is, do not buy any but the best and use the larger sizes, driven by ample power. The hand cutters are worthless on any farm, and the smaller sizes of power cutters but little better for all ordinary farm purpose. At the time for cutting cornstalks most farmers have plenty of idle horses; with these drive a powerful cutter at high speed and do rapid work if you hope for any profit from the operation. Probably two-thirds of all the feed cutters bought in the state are only used a few weeks or months and are then set aside until sold for old iron.

This year we did not measure the area from which the fodder used in the first trial was taken, but assuming it to be the same as last year from the same field, 3,490 pounds per acre, we can find the value of our cut and uncut stalks measured in butter.

Upon calculation it will be seen that an acre of uncut cornstalks supplemented by 1,690 pounds of grain feed would give a product of 158 pounds of butter. It should be remembered that the corn produced on the acre is not here taken into account. The composition of the grain feed is five pounds of bran to five of corn meal and three of shorts. This mixture is worth about fourteen dollars per ton on the average in this state. In the same manner we find that an acre of stalks cut and crushed as described, supplemented by 2,685 pounds of the grain mixture would give a butter product of 242 pounds.

Again, let us assume that the uncut stalks are worth $4.00 per ton and the cut stalks $5.00; with the grain feed at $14.00 per ton, the cost of food for one pound of butter from the cut stalks is 12.2 cents, and from the uncut stalks 13.1 cents. These prices seem reasonable considering the values placed upon the food.

With the second trial are some interesting conclusions. The yield of fodder corn, ears and all, of the Stowell's Evergreen sweet was 11,232 pounds per acre. 1,600 pounds of this fodder when cut together with 320 pounds of bran, made 45 pounds, 6 ounces butter; when uncut it made 41 pounds, 7 ounces. At these rates one acre of uncut fodder supplemented by 2,256 pounds of bran would make 290 pounds of butter. The bran at $12.00 would be worth $13.47. 290 pounds of butter at 20 cents (winter price) would be worth $58.00 Substracting the cost of the bran we have $44.53, as the value of one acre of Stowell's Evergreen sweet corn fodder when manufactured into butter. The cost of growing and caring for a crop of corn when no husking has to be done is small, as any farmer knows.

It should be noted here that with this corn the stalks stood about one-third thicker in the row than for a crop of corn, and that many ears and nubbins, especially the latter, were produced, though the crop was not above the average of fair yields. Again, it should be stated that the cows were further along when this last test was made than the previous one, and from several causes have dropped considerable in milk flow.

Whether these experiments have accomplished the intended results or not, it is hoped that they will draw the attention of some to the great value of Indian corn for the dairy. It is the crop to which we must look for cheap food, out of which to make cheap butter to meet the demand for lower prices.

CLOVER ENSILAGE AS A PARTIAL FOOD FOR DAIRY COWS.

By W. A. HENRY.

In this experiment we have the cost of producing milk and butter in the spring from cows that are kept up and fed in the barn. The period is before clover is large enough to cut for soiling and after cows are ordinarily turned out to grass. Though not satisfactory in some respects, it is given with the belief that it will help some of the readers of this report, who are trying to carry a large number of cows on a limited area.

In the fall of 1883, we placed in our stone silo a quantity of second crop clover drawn directly from the mower and packed at once without preparation or further handling in anyway. This ensilage covered with planks and weighted with stone remained untouched for more than a year. The winter of 1884-85 we fed from the silo, but had a good block left until late in the spring. This ensilage, which was about twenty months old, was used in the experiment here reported. A week's preliminary feeding preceded the trial. The cows were fed in the barn and allowed to exercise in the barn yard. The trial began on the evening of May 21, 1885, and closed on the 9th of June, all the good ensilage having been consumed at that date. In addition to the ensilage clover hay was fed together with a grain ration of six pounds per day per cow of corn and barley meal, and an equal amount of bran. In the first feed of the first day the bran was short by one pound for each cow.

Arranging the results so that they may be easily studied we have the following:

THREE COWS IN NINETEEN DAYS,

CONSUMED.	RETURNED FOR THE FOOD EATEN.
1,950 pounds clover ensilage.	1,342 pounds 2 ounces milk.
654 pounds mixed hay.	
339 pounds wheat bran.	Which made:
342 pounds corn and barley meal.	63 pounds 2 ounces of butter.

The value of the feed given may for this locality be figured thus:

Clover ensilage, 1,950 pounds at $3.00	$2 92
Clover hay, 654 pounds at $8.00	2 61
Wheat bran, 339 pounds at $12.00	2 03
Corn and barley meal, 342 pounds at $16.00	2 73
	$10 29

The food necessary to produce a pound of milk then costs seventy-seven cents a hundred pounds, and that necessary to produce a pound of butter, 16.3. The skim-milk and butter-milk left after making the butter, would, at twenty-five cents per one hundred pounds, be worth $3.19. Deducting this from the cost of the food it leaves the cost of the butter 11.2 cents per pound for the food consumed.

The reader will notice that the grain ration fed in this trial was, all things considered, a heavy one. By referring to the table of digestible nutrients given in Prof. Armsby's part of the report and using the factors there given, we find that our cows consumed more food than the Germans have found necessary to maintain the full milk flow. By the table we find the components of our ration to be for each cow per day as follows:

AVERAGE FOOD CONSUMED PER COW PER DAY.	CHEMICAL COMPOSITION.		
	Protein.	Carb-hydrates.	Fat.
36 lbs. clover ensilage	0.81	3.98	0.23
12 lbs. clover hay	0.75	4.55	0.12
6 lbs. corn and barley meal	0.57	3.57	0.17
6 lbs. bran	0.74	2.60	0.18
	2.87	14.70	0.70
German standard for a cow	2.50	12.50	0.50
Excess in our ration	.37	2.20	0.20

This excess of food is considerable, and if we accept the German tables as correct guides, we could have fed only half as much clover hay as we did, and still have obtained as good results. Whether or not that is a fact, unfortunately we cannot now tell.

SOILING VERSUS PASTURING FOR DAIRY COWS.

By W. A. HENRY.

The question of the practicability of cutting and carrying food to dairy cows, instead of allowing them to gather it themselves, is one that comes to the mind of every dairyman, as he finds his herd of cows increasing beyond the capacity of the pasture. Soiling belongs to intensified farming, and some of our leading dairymen believe in that system, and are pushing more and more toward producing a large amount of milk and butter from a comparatively small area of land. The experiment here reported is given with the hope that it will show some of the factors that enter into this problem. To solve the problem each man must say to himself, how much feed can I raise to the acre, and what is the cost of raising and getting it to the cows. It is almost purely a business calculation, the only other difficulty being that the cows do not live as naturally when shut up in yards or barn all the year round as when a portion of the year is spent in the pasture. With the price of land and the cost of labor and value of the product known, it is believed that the figures here given will aid those who may be thinking upon this problem, some additional data upon which to base their calculations.

For this experiment six cows were used, three in each lot. As the cows of our own herd usually calve in the fall, we were obliged to purchase five of the six animals used, and though a due amount of care was exercised in selecting, we found that our animals were of but average butter capacity. There were two mature cows and one heifer in each lot, but the heifers were fully equal to the cows for butter.

THE PASTURE.

Two and a quarter acres of upland pasture of dense Blue grass sod were fenced off from our large pasture for the use of the pasture cows. It was thought at first that this would support the cows, but failing to do so we added a lot having an area of one and forty-five one hundredth acres to be used supplementary to the first. Both these pastures had been used by the farm herd up to the time the experimental cows were turned upon them. The first pasture gave signs of failing one month after the trial began, and the cows were changed from it to the smaller one for a time; when the first had grown up somewhat the cows were turned back again. For a time one was used for day and the other for night pasture. About September 1st, we saw that the grass was growing faster than the cows were eating it, and some calves were turned in to eat down the extra growth in the smaller pasture. The extra feed would probably here equaled the pasture of one cow one month. Still in an ordinary season the area of those two lots would not have been more than sufficient for the three cows, and it would not do to place this number of cows on a smaller area. This makes in our case about one and a quarter acres of pasture land necessary for one cow.

THE SOILING CROPS.

The feeds used for soiling were green clover, oats and corn grown upon land of a quality equal to that of the pastures. The clover had been somewhat injured by freezing out the previous winter, and though we selected the best we could find, the yield was slightly less than it should have been. The area of land in clover was 30,651 square feet. This was mowed three times giving the following returns:

First cutting	10,939 pounds.
Second cutting	3,995 pounds.
Third cutting	3,858 pounds.
Total	18,792 pounds.

This is at the rate of 27,000 pounds per acre. I have no doubt that a good stand on rich ground will give fifteen tons of green clover per acre in a fair season, if the first cutting is taken off early so as to give two additional cuttings. We found the third cutting made up of a short growth, mostly leaves, but it was heavier than we supposed it to be, as we found upon weighing. Clover so small as this was, is seldom cut by our farmers yet the weight and value is very considerable. Two varieties of corn were used, Stowell's Evergreen Sweet and a Mammoth late dent. The Stowell's Evergreen was planted in drills with the grains one inch apart on rich ground. When the plants were three feet high we began to thin out by cutting out three or four stalks in a place every two and three feet, and carrying to the cows. By thinning in this way we secured the maximum weight from this plat. The area planted to this corn was 23,494 square feet, and the yield in green fodder corn was 19,253 pounds. The fodder was of good quality having many small ears on it. Of the Mammoth corn a part was fed green and later, when frosts had occurred about the first of October a part was fed from the shock when partially cured. That which was fed perfectly green gave a yield at a rate of 52,569 pounds per acre.

Of green oats we fed 2,385 pounds cut from 6,474 square feet of ground, this gives a weight of 17,592 pounds per acre.

YIELD OF GREEN CROPS PER ACRE.

Now that the subject of ensilage as well as soiling is making the yield of crops in a green state a question of great interest, a summary of the yields in these cases will not be uninteresting. From these figures given above we have the following yields at the same rate:

Green oats	17,592 lbs. per acre.
Green clover	27,000 lbs. per acre.
Green sweet corn	35,743 lbs. per acre.
Green Mammoth corn	52,564 lbs. per acre.

A little over half the sweet corn fodder was run through the feed cutter, but the cow's mouths became sore from the sharp bits of stalks, and they dropped off in milk; the flow was restored upon feeding the fodder long. By feeding the fodder uncut there was a waste of 1,655 pounds during the trial. Over a third of waste came from the partially dried fodder fed after the frost in October; the balance was from the uneaten stalks of the sweet corn.

RESULTS OF THE TRIALS.

Amount of feed for three cows 122 days = one cow 366 days:

Green clover	18,792 lbs.,	cut from 30,651 square ft.
Green fodder corn	23,658 lbs.,	cut from 29,154 square ft.
Green oats	2,385 lbs.,	cut from 6,474 square ft.
Total fed	44,835 lbs.	Total area 66,279 feet
Amount of waste	1,655 lbs.	
Total eaten	43,180 lbs.,	from a trifle over 1½ acres.

This is 118 pounds of green food actually consumed per cow, per day.

The yield of the two lots of cows may be stated thus: Three cows in 122 days on 3.7 acres of pasture produced:

Milk	6,582 lbs., 13 oz.
Butter	303 lbs., 2 oz.

Three cows from 1½ acres of soiling crops produced:

Milk	7,173 lbs., 2 oz.
Butter	294 lbs., 12 oz.

It will be noted that the cows fed by soiling produced nearly 600 pounds more milk and more than eight pounds of butter less than the cows on pasture. The soiled cows lost considerably at the time when the cut cornstalks made their mouths sore; except for this mishap they would without doubt, have made as much butter as the cows on pasture.

From this table we see that with these cows, in four months, we got the following returns:

One acre pasture gave us 1,779 lbs. of milk, which made 82 lbs. of butter.
One acre in soiling gave us 4,782 lbs. of milk, which made 196 lbs. of butter.

It will be remembered that the experiment began the 15th of June, when the first soiling crop, Red clover, was ready for feeding. By starting our pasturing so late we lost a full month, so that we do not get the full value of our pasture in this experiment. We can add to our product from one acre of pasture, therefore, something like a fourth more than we have stated to get the full amount to be put to its credit. This makes the milk product 2,224 pounds and the butter 102 pounds from one acre of excellent Blue grass pasture, in a very favorable season, with cows of fair quality. I am confident we have several cows that would have done from ten to thirty per cent. better for the season under the same conditions.

CONCLUSIONS.

It is fair to state, then, that by soiling in summer a certain area of land will yield double the amount of milk and butter than it will when pastured. The large amount or rather great weight of food consumed daily will be a surprise to many who have not carefully weighed green food for stock. A study of our figures shows that in the month of June the cows consumed 116 pounds of first crop clover daily each, so that the weight of food consumed daily did not differ materially whether fodder corn or clover.

Our cows were of such quality that any farmer in the state, with the least ambition to own a good herd could exceed our results if he exercises judgment in breeding for butter. These cows should have given a pound of butter a day during this trial on the same feed. They ate enough to have done so, and we should then have been able to show better results with both pasture and soiling. Had cows from our own herd been fresh and used we could easily have shown a pound of butter per day through the trial.

Our results show that for one season at least, just as good results can be had from half the land by soiling, as when pasturing. The cost of the two methods will not be discussed as we could institute no comparison that would be at all applicable to the general dairyman from this trial. The time of man and team going to and from the field for the clover or corn for our three cows, was the same as for a large herd. This part of the problem can easily be left to the practical dairyman to figure out for himself. But no matter how or what the figures show, let our dairymen and farmers wake up to the necessity of partial soiling in midsummer when the pastures grow short. It will be remembered that we kept three cows up to July 15th on 2¼ acres, but that at that date the grass began to fail and we had to fall back on 1.45 acres additional. Had we not done this we would have injured the first pasture seriously, if not ruined it, for fall feed, and had the cows drop off largely in milk; here would have been a double loss and one of no small magnitude. By having a good area in soiling crops to fall back upon, we might have partially soiled these cows for a couple of months, and so not needed this one and a half acre lot at all. Without a soiling crop to fall back upon, the farmer who stocks his pasture to its capacity in early summer, will find the grass cropped too short in midsummer and a decreased flow of milk; if he does not stock to the early summer capacity he loses by so much, as the grass grows long and remains uneaten. Let partial soiling become more common in Wisconsin, and we can by an increased milk and butter yield largely make up for the lower prices for the product. He who practices partial soiling for a season, by the results obtained can judge whether or not it will pay them to extend the practice. Moreover, he has learned how to grow and secure soiling crops, and the cost and trouble of handling them. Gradual changes are better than violent ones.

WILL IT PAY TO RAISE THE CALVES OF CHEESE COWS FOR BEEF.

By W. A. HENRY.

In our cheese districts thousands of calves are slaughtered each season, many dairymen raising none whatever, but buying cows as they may need them to keep up their herds. This great slaughter has led some persons to urge that a part at least of these calves be reared to maturity, arguing that there would be a good profit in the business. This is a question of no small importance, and it was thought best to test the matter with considerable care. It was planned to get good representative calves from some cheese district and rear them to maturity, keeping a strict account of everything eaten and the weight of the animals at different stages of growth.

The cost of making a pound of beef is an important one, and worthy of careful study. Of course it is variable, depending upon the grade of stock used, the amount and quality of food given and the skill and judgment used in feeding. The stock of cheese districts is usually promiscuously bred and contains no considerable amount of shorthorn or other beef blood in it. This fact is against us in this problem; still our project was to find out just what could be done with such stock, let the results be what they might.

Accordingly Mr. H. J. Anderson, a butcher at Lake Mills, Jefferson county, secured for us early in June, 1885, nine calves from farmers in that vicinity supplying cheese factories with milk. Seven ordinary calves were purchased about Madison. As they come to us they were from four days to four weeks old. They were on the whole a fair lot, those from Lake Mills being slightly superior to those from the vicinity of Madison. Fourteen of the sixteen were males and were castrated during the second week of the feeding trial.

Each calf stood in a stall by itself, fastened by a strap about the neck and a snap to a ring which slipped up and down on an upright post. They were kept in the barn during the day and the room was darkened so that the flies would not trouble; at night they were turned in the barnyard until they were old enough to eat grass when they were furnished good night pasture.

At first part full milk was fed to the youngest, but this was soon changed to skim-milk. The milk ration of each calf was at first 15 pounds of sweet skim-milk daily given in three feeds. This was carefully warmed to blood heat in every intsance. Later in the season the amount of milk was gradually reduced until at the close of 14 weeks we fed but little over 10 pounds per day in two feeds. That the milk, from Cooley cans, was well skimmed, may be seen from the fact that we have made 5 pounds of butter this summer from each 100 pounds of milk set. We at once began to teach the calves to eat other food. Contrary to past experience, they showed no liking for whole oats, which we hold to be the best calf food aside from milk, so we were forced to supply them with ground grain. As usual, they showed no liking for the food placed in their mouths at first, but in trying to work it out they got a taste of and soon took to it.

As to the grain ration, instead of limiting it as with the milk, our whole anxiety has been to get the calves to eat to their utmost without getting off feed.

As soon as they grew tired of one grain or combination we changed to another. The grain ration was always placed before them just after giving them the milk.

In addition to the grain ration (always ground, of course) they were given a wisp of hay, just a few mouthfuls at first, after each meal; later, green grass in abundance was substituted.

To facilitate the study of this experiment, the time has been divided into periods and the gain in weight and amount of food consumed during each period is stated by itself. This plan, it is thought, will be satisfactory to all interested.

FIRST PERIOD, JUNE 22, 1885, TO SEPTEMBER 28 — 14 WEEKS.

Herewith is given the amount of food consumed during this period by the 16 calves, together with its value at prices stated:

Sweet skim-milk, 20,645 lbs., at 25 cents per 100 lbs.	$51 61
Ground oats, 175 lbs., at $20 per ton	1 75
Ground corn, 373 lbs., at $16 per ton	2 98
Ground corn and oats, 240 lbs., at $18 per ton	2 16
Ground wheat, 196 lbs., at $20 per ton	1 96
Ground barley, 85 lbs, at $20 per ton	85
Bran, 506 lbs., at $12 per ton	3 03
Shorts, 563 lbs., at $14 per ton	3 94
Hay, 420 lbs, at $8 per ton	1 68
Green corn fodder; 280 lbs., at $2 per ton	28
Grass, 3,510 lbs., at $2 per ton	3 51
New milk, 420 lbs., at 50 cents per 100	2 10
57 nights' pasture, at 8 cents per night	4 56
Total value of food consumed	$80 41

TABLE SHOWING FORTNIGHTLY GAIN OF THE 16 CALVES AND DAILY GAIN PER CALF DURING THE FIRST PERIOD.

Date.	Weight of lot.	Gain of lot in 14 days.	Daily gain per calf.
	lbs.	*lbs.*	*lbs.*
June 22	1,934	....	....
July 6	2,220	286	1.2
July 20	2,552	332	1.4
Aug. 3	2,852	300	1.3
Aug. 17	3,179	327	1.4
Aug. 31	3,567	388	1.7
Sept. 14	4,064	497	2.2
Sept. 28	4,494	430	1.9

A total gain of 2,560 pounds in 14 weeks.

In attempting to discuss an experiment like this one meets with the difficulty of assuming prices for the food consumed. Some persons insist that the prices charged for the feed should be just what it costs the farmer to raise. It would seem, however, since few can definitely set that price, the common market price should be the one assumed. Here again we are in trouble, for the prices of hay and grain vary considerably in different sections of our own state. It is deemed best to assume rather high average prices, such as the farmer would be satisfied to obtain for his hay and grain. If the prices used in these calculations seem high, the reader can scale them to suit the markets with him, and find the cost per pound of growth if under his own conditions.

Another point is the care of the stock; no charge has been entered for this as it is a difficult matter to settle. In general the rule of good farmers that *the manure will pay for the care of the stock* is a safe one, and we will so hold it in this discussion. With the prices assumed, it will be noted that the cost of the food consumed is $80.41 for the first period, and that the gain in weight is 2,560 pounds. Dividing the cost of the food consumed by the gain in weight; we find the cost of growth with these sixteen calves is $3.14 per hundred weight for the first period of fourteen weeks.

SECOND PERIOD, SEPT. 29–DEC. 21, 1885—12 WEEKS.

During this period the calves were weaned from milk. For a time they were out nights on pasture, but later were kept up constantly.

The following table shows the food consumed during this period:

Corn meal, 158 lbs., at $16 per ton	$1 26
Oats and corn ground, 1,140 lbs., at $18 per ton	10 26
Wheat ground, 556 lbs., at $20 per ton	5 56
Shorts, 1,765 lbs., at $14 per ton	12 35
Bran, 679 lbs., at $12 per ton	4 07
Hay, 2,023 lbs., at $8 per ton	8 09
Cornstalks, 3,810 lbs., at $4 per ton	7 62
Ensilage, 788 lbs., at $3 per ton	1 18
Skim milk, 1,190 pounds at 25c per cwt	2 97
25 nights' pasture at 8c	2 00
Salt (estimated) 50 pounds at ½c	25
Total cost of food consumed	$55 61

TABLE SHOWING FORTNIGHTLY GAIN OF 16 CALVES AND DAILY GAIN PER CALF DURING THE SECOND PERIOD.

DATE.	Weight of lot.	Gain of lot in 14 days.	Daily gain per calf.
	lbs.	*lbs.*	*lbs.*
September 28	4,494	....	....
October 12	4,758	264	1.1
October 26	5,072	314	1.4
November 9	5,426	354	1.6
November 23	5,540	114	0.5
December 7	5,788	248	1.1
December 21	6,139	351	1.5

This shows a gain of 1,645 pounds in twelve weeks. Dividing this into the cost of the food we find we have $3.38 as the cost of 100 pounds of growth for the second period of twelve weeks.

THIRD PERIOD DECEMBER 21, 1885–MARCH 15, 1886.

During this period the feeding was continued as before, the idea being to force the calves to their utmost without cloying them. No food was at any time wasted and no calf was fed so much that it was not ready for the next feed.

Below is given the amount and estimated cost of the food consumed during this period of twelve weeks.

Bran, 1,270 lbs., at $12 per ton	$7 62
Corn and oats ground, 725 lbs., at $18 per ton	6 52
Corn, 591 lbs., at $16 per ton	4 72
Oats, 1,332 lbs., at $20 per ton	13 32
Shorts, 2,165 lbs., at $14 per ton	15 15
Hay, 5,370 lbs., at $8 per ton	21 48
Ensilage, 7,255 lbs., at $3 per ton	10 88
Cornstalks, 570 lbs., at $4 per ton	1 14
Salt, 72 lbs., at $10 per ton	36
Total cost of food	$81 19

TABLE SHOWING FORTNIGHTLY GAIN OF 16 CALVES AND DAILY GAIN PER CALF DURING THE THIRD PERIOD—12 WEEKS.

DATE.	Weight of lot.	Gain of lot in 14 days.	Daily gain per calf.
1885.	*lbs.*	*lbs.*	*lbs.*
December 21	6,189	....	....
1886.			
January 4	6,369	230	1.0
January 18	6,507	138	0.6
February 1	6,915	408	1.8
February 15	6,998	83	0.3
March 1	7,421	423	1.9
March 15	7,621	200	0.9

A total gain of 1,482 pounds in 12 weeks. Dividing this gain into the total cost of food consumed we have as the cost of 100 pounds of growth, $5.47.

FOURTH PERIOD, MARCH 16 TO APRIL 26—SIX WEEKS.

Continuing as before, but with a period of only six weeks, which carries up to time to turn into pasture, we have the following results.

Total amount of food eaten by sixteen calves in six weeks:

Bran, 1,485 lbs., at $12 per ton	$8 91
Shorts, 1,067 lbs., at $14 per ton	7 46
Corn, 1,713 lbs., at $16 per ton	13 70
Oats, 295 lbs., at $20 per ton	2 95
Cornstalks, 2,300 lbs., at $4 per ton	4 60
Hay, 1,340 lbs., at $8 per ton	5 36
Salt, 36 lbs., at $10 per ton	18
Total cost of food	$43 16

TABLE SHOWING THE FORTNIGHTLY GAIN OF SIXTEEN CALVES AND DAILY GAIN PER CALF FOR THE FOURTH PERIOD—SIX WEEKS.

DATE.	Weight of lot.	Gain in 14 days.	Daily gain per calf.
	lbs.	*lbs.*	*lbs.*
March 15	7,621	....	....
March 29	7,813	192	0.8
April 12	7,993	180	0.8
April 26	8,137	144	0.6

A gain of 516 pounds in six weeks.

Dividing this gain into the cost of the food consumed, we find the cost of 100 pounds of growth during this period was $8.36.

Reviewing the results we find the cost of gain for the several periods to be as follows:

First Period, 14 weeks, 100 pounds of gain cost	$3 14
Second Period, 12 weeks, 100 pounds of gain cost	3 38
Third Period, 12 weeks, 100 pounds of gain cost	5 47
Fourth Period, 6 weeks, 100 pounds of gain cost	8 36

It will be seen that considering the large prices allowed for the food consumed, the cost of growth during the first two periods, covering 26 weeks, is very low; on the other hand, for the third period the cost is high, and for the last six weeks beyond all reason.

It will be seen from the statements of food given that we fed heavily with bran, shorts, corn and oats, but in no case did any calf get more than it would eat with signs of a good appetite. Had the feed been largely corn it might be said that the heating feed had gradually ruined their digestive apparatus. This may be true as it is, but one would hardly expect such effects from bran and shorts which formed the bulk of the concentrated food. It is quite certain, however, that be the explanation what it may, the calves for the last eighteen weeks gave but poor returns for the feed. This high feeding seems to have done well enough for half the winter, but failed in the latter part.

During the week succeeding the last reported the calves were turned out to pasture. Of course they were in excellent condition for going on to grass, and in their growth this summer we may get back all that was lost in the latter part of the winter. Until we see the outcome of the summer's feeding it is not best to make too bold statements as to results so far obtained. It is certain we have sixteen fine, thrifty-looking calves that weigh altogether over 8,000 pounds, and not yet a year old.

A portion of these calves will be kept this summer on the same pasture on which we kept the three cows mentioned in the soiling experiment of last season. Then 3.7 acres made in four months 297 pounds of butter; we will now have the opportunity to see how many pounds of beef we can get from the same area with the stock in question. It is proposed this season to secure some good Short Horn grades and repeat the trial with them to see what results we will get.

FEEDING EXPERIMENTS WITH PIGS.

By W. A. Henry.

The low price of pork, both present and prospective, makes it imperative that we study the very cheapest way of handling and feeding hogs. All over the state our hogs are bred so fine that with the unnatural methods of feeding and handling, diseases break out from apparently slight causes, and the stock dies off rapidly, showing but little power of resistance. Add to these losses the low prices and it becomes evident that much study is necessary to enable our farmers to make pork raising as successful in the future as it has been in the past.

At the Station, heretofore, we have been but poorly prepared to carry on experimental work with hogs, but now that our new hog house is completed we can conduct feeding trials with the least possible expense for attendance.

In the future we plan to kill and dress, a part at least, of the animals experimented upon, to study the effects of feed upon muscle, bone and fat tissue. So far in breeding and feeding, every one has aimed at producing the greatest amount of fat for the least food in the shortest time; feeding for lean, juicy meat has been wholly neglected. Prof. J. W. Sanborn, of the Missouri State University, has shown in recent experiments that the lean meat of the hog can be greatly increased by proper feeding. We hope to take up work in the same line the coming season.

The feeding trials here reported, are given not with the belief that they are conclusive on any one point, but the figures may not be without interest to pork raisers and will aid in the discussion of what is the cost of making a pound of pork.

CORN-MEAL, SHORTS AND A MIXTURE OF THE TWO AS A FOOD FOR PIGS.

Nine plain bred pigs, with some Berkshire blood in them, one hundred days old at the time of beginning the trial, were used. They were divided into three lots, placed in separate pens and given feed which had been mixed with water and allowed to stand until just beginning to sour. Each lot was given all that could be eaten up clean, but no more.

To Lot I was given corn-meal exclusively; to Lot II shorts from the roller process milling, while Lot III received a mixture of shorts and corn-meal in equal parts by weight.

The following are the analyses of the shorts and corn-meal as made at the Station laboratory:

	Shorts.	Corn-meal.
Water	14.87	15.60
Fat	5.63	4.38
Nitrogen	2.78	1.69
Ash	3.33	1.28

The trial lasted forty-two days with the following results:

FEEDING TRIAL WITH PIGS.

Corn-meal, shorts and an equal mixture of corn and shorts.

	Weight of pigs July 20.	Weight of pigs August 31.	Gain in forty-two days.	Food eaten.	Value of food eaten.
	lbs.	*lbs.*	*lbs.*	*lbs.*	
Lot I. Corn-meal.......	188	292	104	558½	$4 46
Lot II. Shorts........	176	271½	95½	501	3 50
Lot III. Mixture.....	185	292	107	469½	3 51

In this table it is assumed that corn-meal is worth $16.00 per ton and roller process shorts are worth $14.00 per ton.

From these figures we find that to make a pound of growth with these pigs required:

5.3 pounds corn-meal, worth 4.3 cents.
5.3 pounds shorts, worth 3.7 cents.
3.3 pounds shorts and corn-meal, worth 3.3.

We see that when we fed corn-meal and shorts separately that it required the same amount, 5.3 pounds of either, to make a pound of growth, but as in Wisconsin shorts can usually be procured cheaper than corn-meal, the shorts made the cheaper pork. When the shorts and corn-meal were mixed half and half by weight, we obtained the best results, the pigs gaining the fastest and eating less by about one-fourth than when fed on corn-meal alone. With this mixture the pork cost 3.3 cents per pound, live weight,

Another point which may be of interest to some farmers and should be to all, is that the manure from the hogs fed on shorts is worth fully twice as much as manure made in feeding an equal amount of corn. By examining the analyses of corn-meal and shorts it will be seen that the nitrogen and ash, the two valuable fertilizing constituents of the food, are in much greater amounts in the shorts than in the corn-meal. It is a rule with many good farmers that the manure of fattening animals pays for the time used in taking care of the stock. If this is true, and it is without doubt, the one who feeds shorts gets double the pay for his work.

CORN AND SHORTS AS FOOD FOR HOGS.

Two lots of three hogs each, the same animals in part as were used in the preceding trial were fed in two parts of corn in the ear to one part of shorts by weight. The experiment began January 6, 1886, and closed February 3d, lasting twenty-eight days. The shorts were mixed with a little warm water in the trough at feeding, and the corn was given in the ear.

Three of the hogs were in a common cheap pen but given good bedding, the other lot were in warmer quarters, but showed no advantage over the first lot from this fact.

The results show that with Lot I, three hogs, weighing 550 pounds, in 28 days ate

449 pounds corn, worth 35 cents per bushel	$2 61
and 224½ pounds shorts, worth 70 cents per 100	1 57
Total	$4 18

and gained 102 pounds. This makes the cost of the pork 4.1 cents per pound live weight.

Lot II was fed in the same manner as Lot I, with the following results:

Three hogs, weighing 587 pounds, in 28 days ate

497½ pounds of corn, worth 35 cents	$2 88
and 248¾ pounds of shorts, worth 70 cents	1 73
Total	$4 61

and gained 105 pounds. This makes the cost of the pork, live weight, nearly 4.4 cents per pound.

FEEDING CORN ALONE.

The hogs used in the last test were again put on trial, receiving in this case only corn on the cob, and warm water to drink.

They were fed 28 days, from February 3 to March 3d, 1886, with the following results:

LOT I.

Weight of three hogs at beginning of experiment	652 pounds.
Gain in 28 days	92 pounds.
Amount of corn eaten	756 pounds.
Value of corn at 35 cents per bushel	$4 42
Cost of one pound of pork	4.8

LOT II.

Weight of three hogs at beginning of experiment	692 pounds.
Gain in 28 days	90½ pounds.
Amount of corn consumed	792 pounds.
Value of corn, 35 cents	$4 62
Cost of one pound of pork	4.6

COOKED VERSUS UNCOOKED FOOD.

Four lots of three hogs each were used in the trial. They were half-blood Jersey Reds, the sire being a recorded Jersey Red and the sows high grade Poland Chinas. They were 179 days old at the beginning of the trial. To Lot I there was given one part shorts and two parts shelled corn, thoroughly cooked by steaming. To Lot II there was given two parts shorts and one part shelled corn, thoroughly cooked by steaming.

Lot III received the same mixture of food as Lot I, but uncooked. Lot IV received the same as Lot II, but uncooked.

The following are the results:

LOT I—COOKED FEED.

Amount of shorts eaten	165½ pounds.
Amount of shelled corn eaten	331 pounds.
Weight of three hogs at beginning	464 pounds.
Gain in twenty-one days	82 pounds.
Value of corn at 35 cents per bushel	$1.93
Value of shorts at $14.00 per ton	1.15
Total cost of feed	$3.08
Cost of one pound of pork	3.7 cents.

With the next lot the proportions of the rations were reversed, and two pounds of shorts to one of shelled corn were fed. The mixed feed was thoroughly cooked, as before. The following results were obtained:

LOT II—COOKED FEED.

Amount of shorts eaten	286 pounds.
Amcunt of shelled corn eaten	143 pounds.
Weight of three hogs at beginning	467 pounds.
Gain in 21 days	82 pounds.

Value of corn at 35 cents per bushel	$0.83
Value of shorts at $14.00 per ton	2.00
Total cost of food consumed	$2.83

Cost of food for one pound of pork	3.4 cents.

An examination of the droppings of both these lots of hogs showed that a large part of the corn passed undigested; it was thought best, however, to continue and note results.

The two remaining lots were fed the same food as those just described, except that the food was given uncooked. The corn was fed on the cob.

With the third lot one pound of shorts was fed to every two of corn.

The results were:

LOT III—UNCOOKED FEED.

Amount of shorts eaten	180 lbs.
Amount of corn eaten	360 lbs.
Weight of three hogs at beginning of experiment	447 lbs.
Gain in 21 days	110 lbs.

Value of corn at 35 cents per bushel	$2 10
Value of shorts at $14 per ton	1 26
Total value of food consumed	$3 36
Cost of food for one pound of pork	3.0 cents.

LOT IV – UNCOOKED FEED.

Amount of shorts eaten	293 lbs.
Amount of corn eaten	146½ lbs.
Weight of three hogs at beginning	437 lbs.
Gain in 21 days	94 lbs.

Value of corn, at 35 cents per bushel	$2 90
Cost of food for one pound of pork	3.1 cents

We find that as an average of Lots I and II, which were fed on cooked food, the cost of food for one pound of pork was 3.6 cents, while for Lots III and IV, fed on uncooked fosd was less than 3.1 cents. This shows a loss by cooking the food of fully one-half a cent for each pound of pork made, besides the labor of preparing the food.

The hogs on cooked food failed to properly masticate the cooked corn, though the grains were so soft they could easily be mashed between the fingers, and the loss is probably due largely to that cause. We could have changed the experiment when we noticed this fact but preferred to go on and see what the result would be.

The reader can take the experiments for what they are worth; they are certainly suggestive if not conclusive. A positive opinion as to the value of cooking food for swine is withheld until further experiments are made by us, and those now being carried on at the experiment stations and agriculutral colleges can be collected and studied.

VARIATION IN WEIGHT OF FARM ANIMALS.

By W. A. Henry.

The variation in weight from day to day of cattle, even when kept under apparently uniform conditions, is very considerable and often surprising to the feeder. This point should be well understood by all handling stock and especially those conducting any sort of feeding trials. A lack of knowledge upon this point and upon what is a fair daily gain for an animal has led to some most absurd statements in the public press of the wonderful gain in weight of animals on certain feeds. A gain, in one instance, of seven pounds per day per head was reported for a yoke of oxen fed on ensilage; in another case a cow was reported to gain four and three-quarters pounds daily. A third report was a gain of five pounds per day for a steer*

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* These figures are quoted from Conrad Wilson's "Second Letter to Commissioner Loring on the Ensilage Delusion;" published in *American Dairyman*, August 31, 1882.

Had the authors of such claims more experience in weighing cattle they would not have set forth such statements unless they purposely intended to deceive. From our books we could show, of course, a large number of weights of stock made from time to time, but only a few are necessary to our purpose. The figures given below are fair samples on this point.

Here are the weights of the cows used in the first two experiments given in this report:

NAMES OF COWS.	January 7.	January 8.	January 9.
	lbs.	*lbs.*	*lbs.*
Palmer	818	792	820
Doubtful	1,120	1,091	1,127
Bessie	940	922	929
Emma	863	840	850

Later we have for three days these weights:

NAMES OF COWS.	January 21.	January 22.	January 23.
	lbs.	*lbs.*	*lbs.*
Palmer	779	782	778
Doubtful	1,080	1,059	1,045
Bessie	891	867	870
Emma	841	833	836

The cows were weighed at the same time each morning after being fed but before being watered.

It will be seen that Palmer dropped twenty-six pounds from January 7th to 8th, while from January 8th to 9th Doubtful showed a gain of thirty-six pounds. Other cases almost as marked can be selected from these few figures. Now in the gain and loss just mentioned no one will for a minute suppose it to be from any other cause than a variation in the weight of the contents of the alimentary tract, and not in the substance of the body itself.

These variations occurring only twenty-four hours apart show the absurdity of making any definite statements as to gains or losses in experiments without carefully taking all factors into account and getting the average of several weighings rather than relying on a single one.

The following from a paper* prepared by the writer is upon the same topic.

"During the winter of 1883 two lots of cows of two each were placed side by side in comfortable quarters. Rations proportional to the weights of the animals made of oat straw and clover hay, cut fine, together with oil-meal and bran for one lot and oil-meal and corn-meal for the other lot, were given in two feeds. The ration was so adjusted that it was all eaten each day without waste. The cows were fed, milked and watered at regular times twice daily, and were weighed each morning after being milked and fed, but before water was given.

"The table given herewith shows the weight of each lot from day to day, together with the water drank daily. A week of preliminary feeding preceded the part of the trial here reported. In order to present as few figures as possible and to render the variations apparent, 2,150 pounds is assumed as the normal weight of Lot I., and 2,100 pounds as the normal weight of Lot II., while 150 pounds is assumed as the normal amount of water drank by each lot daily. Only the weights, greater or less than these normal weights, indicated by the plus or minus sign, are given.

"The yield of milk was quite uniform, and is not here reported, as it would have no effect on the consideration of this topic.

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*Proceedings of the Fourth and Fifth Meetings of the Society for The Promotion of Agricultural Science, pp. 29-31.

DAY OF EXPERIMENT.	LOT I.		LOT II.	
	Variation from normal weight of 2,150 pounds.	Water drank less than or greater than 150 pounds.	Variation from normal weight of 2,100 pounds.	Water drank less than or greater than 150 pounds.
1	+ 16	+ 64	+ 16	+ 73
2	+ 12	+ 16	+ 12	+ 28
3	+ 28	+103	− 12	+ 82
4	− 12	+ 21	− 24	+ 23
5	+ 28	+ 53	+ 4	+ 26
6	− 30	+ 44	− 27	+ 45
7	− 6	+124	− 28	+109
8	− 24	+ 99	− 15	+100
9	+ 42	+ 56	+ 24	+109
10	+ 40	+ 77	+ 40	+ 54
11	+ 22	+ 47	+ 30	− 21
12	+ 24	+ 59	+ 34	+ 84
13	+ 12	+ 66	− 30	+ 29
14	+ 8	+ 1	+ 20	− 8
15	0	+138	+ 8	+ 84
16	+ 38	+ 44	− 4	+ 62
17	+ 50	+ 58	− 6	+ 61
18	+ 12	+ 80	− 8	+ 34
19	+ 4	+ 93	− 22	+ 28
20	+ 24	+109	− 34	+119
21	+ 48	+ 30	− 32	+ 29
22	+ 70	+119	+ 40	+112
23	+ 40	− 23	0	+ 66
24	+ 88	+ 72	+ 46	+ 60
25	+100	+ 59	+ 34	+ 54
26	+ 58	+ 54	+ 12	+ 94
27	+ 62	+109	+ 10	+ 27
28	+ 64	+ 92	+ 54	+ 89
29	+ 88	+103	− 4	+ 93
30	+ 74	+ 76	+ 22	− 2

"The greatest variation in weight from one day to the next with Lot I. was from the eighth to the ninth days. where there is a gain in weight of sixty-six pounds. From the twenty-first to the twenty-second days Lot II. shows a gain of seventy-two pounds.

"It requires but a little study of the figures, as given, to satisfy one that the variation of these two lots of cows from day to day was considerable, and that in reporting an experiment where such variations occur, erroneous conclusions might be drawn, if the gain or loss in weight for a given period was assumed to be that found by substracting the weight of the lot at the beginning of the period from the weight of the lot at the close, only using single weighings in each case. To illustrate this: Suppose it had been concluded to stop the experiment at the close of the fifteenth day. It could then be reported that Lot I. had lost sixteen pounds in two weeks, or over half a pound per cow per day. Continuing the trial but one day longer, Lot I. shows a gain of twenty-two pounds in fifteen days, or a gain of over two-thirds of a pound per cow per day. Equally variable results could be reached by selecting other dates for comparison.

"In searching for an explanation of these irregularities in weights, one of the first thoughts is, that possibly they are due to the variable quantity of water drank from day to day. It will be seen by the table that on some days the two cows of a lot would drink more than a hundred pounds in excess of other days. In consulting the table, it should be borne in mind that the cows were weighed before being watered, so that the effects of the water upon the weight of the animals would not be seen until the following day. But here we get no help for there seems to be no relation between the two sets of numbers.

"Nor does it appear that changes in the weather are the cause, for, with the two lots of cows, one often shows a gain in weight at a time when the other is losing. To me, the variation appears due to a rapid, or slower, movement of the contents of the alimentary canal, and the whole thing, so far as our purposes are concerned, accidental."

With calves, especially when very young, the uniformity of weight is quite constant; as ther grow older and rumination begins, they are less uniform. Pigs on uniform feed run quite evenly in weight as one would naturally expect.

THE UNIFORMITY OF THE WATER CONTENT OF BUTTER.

By W. A. HENRY.

The remarkable yields of butter reported from time to time, have raised the query with many of how much water was left in the butter in such cases. As we were testing the cows of our own herd from time to time and making tests of various cream raising devices and churns, it was desirous to have some correct idea of the uniformity of the water in butter, for if it varied greatly in different samples without our knowledge, we might be deceived in results obtained. Accordingly, to settle this question, the butter from consecutive churnings was analyzed to find the amount of water it contained. The dairyman worked the butter as usual, and when ready for the market, took a sample which was analyzed. The results are given below:

Date of churning.	Source.	Per cent. water.
August 25	Cooley Creamer	15.92
August 25	Kellogg Creamer	15.33
August 25	Soiling experiment	14.38
August 25	Pasture experiment	15.62
August 25	Soiling experiment	14.00
September 3	Herd milk	20.00
September 4	Pasture experiment	14.23
September 4	Soiling experiment	14.55
September 18	Soiling experiment	15.79
September 18	Pasture experiment	15.90
September 19	Herd milk	14.64
September 21	Soiling experiment	12.34*
September 21	Pasture experiment	17.22*
September 22	Herd milk	12.04
September 24		13.59
September 25	Herd milk	13.04
September 28	Soiling experiment	12.68
September 28	Pasture experiment	12.35
September 28	Herd milk	12.79

* Butter came soft.

The two churnings marked with a * are reported by the dairyman as being poor, the butter coming quite soft. Between these two is a variation of nearly 5 per cent. No note is made regarding the churning of September 3rd, when there was 20 per cent. of water left in the butter, but my remembrance is, that the butter of that date also came very soft. Throwing out this as doubtful we find that when the butter granulated properly either with small churnings made in a small churn, as when the Kellogg and Cooley tests were made, or with the large churn as when the herd milk was churned, the water in the butter varied less than 4 per cent. in the extremes — 12.04 being the lowest and 15.92 the highest. On August 25 the dairyman made five churnings with the extremes of water in the buttter at 14.00 and 15.92, a range of not quite 2 per cent. As the weather grew cooler in September the water content seems to have grown somewhat less. Our arrangements for churning in hot weather are very imperfect, no better than those of any farmer, so that the conditions and season were certainly trying ones.

The reader who may be interested in this subject, is referred to the article further on in this report, "*Results of Churning Trials with Three Different Churns.*" In that article sixteen analyses are given of butter churned in three different churns and worked by two different persons. In these sixteen churnings the lowest per cent. of water in the butter is 14.07 and the highest 15.74, all but two being over fourteen and under fifteen per cent.

When butter comes soft if reasonably worked it will contain a considerable excess of water; upon a second re-working, after it has hardened, it can easily be reduced to a dryer condition than normal. Such has been our experience.

It is evident that a good dairyman should with normal conditions make butter with a quite uniform amount of water in it.

THE KELLOGG SYSTEM OF CREAM-RAISING.

By W. A. HENRY.

The Kellogg method of raising cream was patented by Mr. H. W. Kellogg of Ripon, Wisconsin. It is very simple, consisting of a tank of the desired size, somewhat resembling a cheese vat, in which clean cakes of ice are placed and securely held in position by a grating. The warm, fresh milk is then poured into the vat, coming directly in contact with the ice which rests upon the bottom. The milk is rapidly cooled so that the cream line is more or less distinct after forty minutes. The claim of the inventor is, I believe, simplicity and a rapid throwing up of the cream, so that the skim-milk, more or less freed from cream, can be worked the same day into skim or part skim cheese.

The tank or can sent us by Mr. Kellogg for trial was a miniature one, being twelve inches long by eight wide and nine inches high in the clear, made of tin with a faucet at the bottom to draw off the skim-milk. A grating of wire fastened with clamps held down the ice. For each trial a cake of ice weighing about ten pounds was sawed to fit the can. The Cooley can used in the trials here reported was of less diameter than the regular cans. This brought a smaller amount of milk to the full height of that in larger cans.

FIRST TRIAL.

Fifteen pounds of mixed milk were poured into the Kellogg can, having a small cake of ice in it, and an equal amount into a Cooley can. The latter was plunged into the Cooley tank of water with ice in it, holding the remainder of the farm milk, while the Kellogg can set on a bench near by. At the end of two and a half hours the Kellogg can was skimmed, but the Cooley can not until just previous to the next milking, or about eleven hours after being set. The cream from each can was placed by itself, and later when a sufficient amount had accumulated, churned.

Herewith are the results in tabular form:

DATE.	Amount of milk for churning.	Amount of butter—Cooley.		Amount of butter—Kellogg.	
	lbs.	*lbs.*	*oz.*	*lbs.*	*oz.*
August 22–25	105	4	6½	4	7
August 26–28	75	3	2	2	15
August 29 to September 2	135	4	5½	4	10
September 2–4	75	3	4½	3	6
	390	15	2½	15	6

This shows a gain of three and a half ounces of butter in favor of the Kellogg from 390 pounds of milk.

SECOND TRIAL.

In this more details were noticed. The Kellogg milk stood but two hours and the Cooley as before, from one milking to the next. Twenty pounds of milk were set each time, this filling the Kellogg can completely. A smaller Cooley can than the regular size was chosen to hold the other portion of the milk.

The amount of ice placed in the Kellogg can and the amount melted by the milk were noted; also the amount of ice used in the Cooley tank where the farm milk was set, together with the Cooley can in question. Tthe cream from sixty pounds of milk, three settings, was churned by itself.

DATE.	Amount of milk for each churning.	Amount of butter—Cooley.		Amount of butter—Kellogg.		Amount of ice used in Kellogg can for 3 settings.	Amount of ice melted in Kellogg can.	Total milk set in Cooley tank.	Amount of ice used in Cooley tank.
	lbs.	*lbs.*	*oz.*	*lbs.*	*oz.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
October 20–21	60	2	11	2	9	30	19	259	130
October 25–26	60	2	11	2	9	28	20	256	167
October 27–28 .:.......	60	2	13½	2	11	28	20	216	151
October 28–29	60	2	12½	2	11	28	19	202	91
Total............	240	11	0	10	8	114	78	933	539

This shows a gain for the Cooley of eight ounces of butter over the Kellogg on 240 pounds of milk, the Kellogg milk standing two hours and the Cooley about eleven.

At the laboratory samples of the full milk and skim-milk from both cans were daily analyzed with the results given below:

	OCTOBER.						
	20	21	25	26	27	28	29
New milk, per cent. fat	4.46	4.20	4.60	4.52	4.73	4.55	4.73
*Kellogg skim, per cent. fat.	1.28	0.91	0.63	0.66	0.98	0.62	0.77
Cooley skim, per cent. fat..	1.19	0.72	0.63	0.43	0.68	0.40	0.58

There must have been an error with the analysis of October 20, either in sampling or the chemical work as the per cent. fat in the skim-milk is very high. From this table we find the average composition of the whole milk to be 4.54

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* The percentages given for the Kellogg skim-milk are calculated for the milk free from the water resulting from the melting ice.

per cent. and that of the Cooley skim-milk to be 0.66 per cent. and that of the Kellogg to be 0.83. These analyses agree very closely with the results shown by the churn. It is evident that the Kellogg does not throw up all the cream in two hours, that it could were the process continued longer. For skim cheese making probably there would be no demand for close skimming; in fact, better not skim at all.

The large amount of fat left by both processes in the skim-milk, arises, no doubt, from the cooling of the milk previous to setting it. To get samples for the two cans of equal quality it is necessary to pour milk from one vessel to another two or three times, which cools the fresh milk; then it must be carefully weighed out into each can. In these operations, necessary to the experiment, we account for the large amount of fat in the skim-milk.

We note by the table that the ice used by the Kellogg was forty-five per cent. of the weight of the milk set and of this ice seventy-eight per cent. was melted during the two hours in cooling the milk. In the large tank where ice remained all the time, we used during the trial fifty-eight per cent. of the weight of the milk in ice. There would be left in the Kellogg skim-milk the water from the melted ice; in this trial this would be seventy-eight pounds in the skim-milk left from skimming two hundred and forty pounds of milk. This would be an addition of about one-third of water to the skim-milk. Mr. Kellogg claims that this extra water is no detriment in making skim-milk cheese.

RESULTS OF CHURNING TRIALS WITH THREE DIFFERENT CHURNS.

By W. A. HENRY.

Churning tests were made on the days named in the accompanying table with the churns therein designated, viz.: the Domestic Jewel, made by the Racine Refrigerator Company, Racine, Wis.; the Rectangular, made by Cornish, Curtis & Greene, Fort Atkinson, Wis., and The Boss, a barrel churn, made at Rockford, Ill.

The Domestic Jewel was operated by Mr. L. Murch, the patentee, and the butter made by his churn was handled by him alone, in my presence. The Domestic Jewel is a cylinder churn lying horizontally, with revolving paddles running close to the inside of the cylinder.

The Rectangular was one used at the Station, No. 0, size, and was operated by the station dairyman, Wm. H. Moon.

Mr. W. A. Walker, of the Racine Refrigerator Company, churned the butter with Barrel churn, but in no way handled the cream before or the butter after churning. Each churn was prepared in the same way for churning and equal weights of mixed cream placed in each. The churnings of June 9, 13, and last one made on June 16, were from cream raised at the Station dairy-house, in the Cooley Creamer; the other churnings were of thicker creams raised in shallow pans and secured for the trials at farm houses by Messrs. Walker and Murch.

Mr. Murch turned the crank of the Domestic Jewel from 1-6 to 1.4 faster than the other two were revolved, they being governed by the falling of the cream.

All churning stopped with the granulation of the butter. The butter was not salted.

The scales used weighed accurately to the gram (about one-twenty-eighth of an ounce).

All weighings were made by myself or Mr. F. G. Short, the station chemist.

Mr. Murch worked the butter churned by him, and Mr. Moon the other two lots. No judgment was passed on this butter as it was intended to find out the amount of butter secured by each churn when free from water, by analysis in the laboratory.

Samples of the butter were taken by Mr. Short, and the amount of water in each carefully determined in the chemical laboratory. The real test then is amount of water-free butter obtained from each of the churns.

I witnessed and directed all operations, and believe no advantages were gained by one party over another nor disadvantages incurred by any of the operations or movements.

TABLE SHOWING RESULTS OBTAINED FROM EACH OF THE CHURNS.

	JUNE 9, THIN CREAM.		JUNE 11, THICK CR'M.		JUNE 12, THICK CREAM.			JUNE 13, THIN CREAM.			JUNE 16, THICK CREAM.			JUNE 16, THIN CREAM.		
	Domestic Jewel.	Rectangular.	Domestic Jewel.	Rectangular.	Domestic Jewel.	Barrel.	Rectangular.	Domestic Jewel.	Barrel.	Rectangular.	Domestic Jewel.	Barrel.	Rectangular.	Domestic Jewel.	Barrel.	Rectangular.
Ounces of cream churned.....	338.5	338.5	316.4	316.4	251.8	251.8	251.8	282.1	282.1	282.1	289.2	289.2	289.2	349.2	349.2	349.2
Minutes required for churning.	27½	21	11	26	6	7	8	26	26	26	41	47	63	29	22	29
Ounces of unsalted butter...........	73.01	73.72	129.87	128.43	104.37	101.37	102.32	62.89	60.95	62.22	107.23	105.5	105.53	71.39	70.26	70.54
Per cent. of water in butter.......	14.15	14.78	14.50	14.27	14.90	14.07	14.32	15.74	14.71	14.90	14.62	14.12	14.08	15.23	14.22	14.08
Ounces of water-free butter...........	62.68	62.83	111.04	110.11	88.82	87.11	87.67	53.00	51.99	52.95	91.56	90.61	90.68	60.52	60.25	60.61
In favor of Domestic Jewel over Rectangular......	......	......	0.93	......	1.15	... ..	......	0.05	......	......	0.88	......	......	......	... ..	......
In favor of Rectangular over Domestic Jewel.........	......	0.15	......	......	......	......	......	......	......	......	......	......	......	......	......	0.09

It will be noticed that the Domestic Jewel gives the largest amount of water-free butter in every instance with the thick cream, while in two cases out of three the Rectangular gives the largest yield with thin cream. In only one instance does the excess of one churn over the other amount to more than one per cent. of the total butter obtained; that is in the third trial where excess in favor of the Domestic Jewel over the Rectangular is about one and one-third per cent.

Any differences less than one per cent. in the amount of butter may, in my estimation, be due to the errors of churning; that is, two persons may take similar churns and equal amount of cream and vary as much as one per cent. or less and yet both work as carefully as possible. Still a difference occurring repeatedly on one side must be counted favorable to that party.

An examination of the churns just as the cream was breaking into butter, showed quite a patch of cream on the Barrel churn where it centers, that was unchurned. This cream was not dashed off the sides of the barrel at these two points owing to the concave shape of the staves. A little cream was also noted in the pivot corners of the Rectangular churn.

REPORT ON GRAIN TRIALS FOR 1885.

By W. A. HENRY.

WINTER WHEAT.

Spring wheat does not succeed with us on the Experimental Farm, nor has it proved a successful crop for the farmers of this section of the state as a rule for many years past. Even with the fair yield occasionally obtained the quality is so much below that of the spring wheat of the country to the northwest of us that we have to take the lowest quotations for our product. It is an interesting fact however that on many farms where spring wheat growing had been abandoned because of small crops, and farmers went into stock raising, they are now able to get fair and in some cases excellent crops again. Since the general failure of spring wheat there has been an effort at the Experimental Farm to grow winter wheat with the hope that it might prove a substitute. This has succeeded fairly well. The Farm years ago showed the qualities of the Fultz and Clawson varieties which were hardy and gave excellent yields of grain, though not ranking with the higher grades of spring wheat in milling qualities. We have given up growing these and begun the search for other varieties, superior we hoped, but which would at least take their places when they deteriorated as they are almost certain to do in this climate. Herewith are given the results, in even bushels, of the varieties grown for the last three years, 1883, 1884 and 1885. The size of the plots in 1885 were one-fortieth of an acre. In previous years the plots were one-twentieth of an acre. The results are calculated for acres to allow easy comparison.

YIELD OF WINTER WHEAT.

Name of variety.	Yield for 1885.	Yield for 1884.	Yield for 1883.
Sandomirka	28	40	28
Hungarian White Chaff	33	40	28
Velvet Chaff	32	38	32
Russian No. 2	27	48	30
Theiss	39	43	32
Heiges Prolific	28	43	28
Arnold's gold medal	20	42	....
Champion Amber	27	55	....
Wysor	21	43	....
Bennet	38	38	....
Finley	26	52	....
Egyptian	29	48	....
Ostrey	21	49	....
Sparks Swamp	24	40	....
White Rogers	19	50	....
Washington Glass	17	41	....
Martin's Amber	32	41	....
Hallet's Original Red	0	37	....
Sibley's Hybrid Mediterranean	26	42	....
Valley	28	....	....
Zimmerman	24	....	....
Rocky Mountain	40	....	....
Nigger	30	....	....
Tasmanian	31	....	....
York White Chaff	29	....	....
Landreth	30	....	....
Bearded Treadnell	32	....	....
Michigan Bronze	30	....	....

The table shows that our crop for 1885 was very low in comparison with 1884. The grain of 1885 was very poor in quality. At one time in the spring we thought the plots all ruined and had made arrangements to plow them all up. Spring showers and favorable weather made a change in the appearance of the plots and we concluded to let them stand and see if any varieties would show any characteristics that would mark them from the rest. So far we must say that we have found no variety that shows marked hardiness. The Velvet Chaff, a variety much like the Blue Stem spring wheat, gave us some hopes in 1883, but it has not maintained its rank for hardiness. We shall keep on for a time yet in this line of investigation.

OATS.

Fifteen plots of one-twentieth of an acre each were sown with oats May 5th on carefully prepared ground. The land had been in corn the previous season, and had not been manured for the last two years. It was amply rich, however, since if much manure is used the grain lodges and rusts badly even in fair seasons. The plots all grew finely and the test promised to be a very interesting one until a series of storms, beginning with July 8th, threatened to destroy the crop totally. In the storm of the date named the wind had a velocity of 65 miles an hour, and the grain the next morning lay as flat as if it had been mowed. From this disaster the plants never recovered; the yield, as here reported, is considered as remarkably good under the circumstances. All the plots were mowed with a scythe on account of the fallen grain.

YIELD OF OATS FOR 1885.

NAME OF VARIETY.	Amount from one-twentieth acre.	Rate per acre.		Weight per struck bushel.	Remarks.
	Lbs.	Bu.	Lbs.	Lbs.	
White Belgian	66	41	8	34	White.
Rust Proof	80	50	0	33½	Reddish to dark.
White Canadian	79	49	12	31	White.
Hulless or Bohemian	56½	35	10	45	Without hulls; too soft [to grind well.
Welcome	73	45	20	39	White, very small grains.
White Schonen	96	60	0	32½	One of the best appearing grains.
Lost Nation	64	40	0	37	Resembles Welcome, but larger grain.
White German	84	52	16	31	White.
Badger Queen	75	46	28	35	Like the Lost Nation.
American Triumph	42	26	8	26	Rather large white grain.
Black Tartarian	72	45	0	30	Grains very dark at base.
Hopedown	41½	25	30	33	Small grain, white.
Clydesdale	70	43	24	36½	Resembles the We'come, but better.
White Australian	86	53	24	33	White.
Millards' Kans. Hybrid.	90	56	8	33½	Brown to black.
Black Russian	69½	43	14	35	Very dark.

The seed of the Clydesdale and Hopedown was imported from Scotland by Peter Henderson, the seedsman. This seed was very fine, weighing forty-five pounds to the bushel. We shall sow these varieties from our own seed this year to ascertain if any return to the high quality of the Scotch grain is perceptible.

In general there is little, if any, difference in several of the so-called white varieties of oats; we made no careful study on this question, however.

The White Schonen, which has been grown on the Experimental Farm for years, and the seed quite widely disseminated over the state, still keeps at the top of the list for yield, though the grain is not very heavy. Prof. Lazenby, of the Ohio Experiment Station, reports it as among the best for yield with them.

POTATOES.

The ground on which the potatoes were planted was a sandy loam, which had been in corn for several years previous. This was manured with well rotted barn-yard manure at the rate of 20 two-horse loads per acre.

The potatoes were cut to one eye in a piece, with the concave-curved potato-knife, and planted May 16th, one piece in a place, one foot apart in the drill, the drills being three feet, two inches apart. The cultivation was thorough, beginning with harrowing the ground before the sprouts appeared, and repeated use of the cultivator and hoe during the growing season, so that the ground was free from weeds at digging time. A very large yield was the result, but unfortunately the potato rot struck the plot just as the late varieties were closing their growth. Upon detecting the appearance of rot a part of each variety was dug at once and carefully assorted, dried and weighed.

The rot had attacked some of the tubers, slightly. The rotting ceased at once upon digging and drying.

The following table shows the yield of 100 hills of each variety, divided into large and small tubers, and the yield per acre at the same rates:

YIELD OF POTATOES FOR 1885.

NAME OF VARIETY.	YIELD OF 100 HILLS.		YIELD PER ACRE AT SAME RATE.	
	Pounds.		Bushels.	
	Large.	*Small.*	*Large.*	*Small.*
Crane's Potentate	132	35½	302	81
Rural Blush	118	26	270	59
White Star	139½	28½	321	65
E. Sunrise	138	37½	316	85
E. Ohio	130½	23	298	52
Corliss Matchless	118	37½	270	85
E. Maine	103	54	236	123
E. Harvest	114½	52	262	119
Pearl of Savoy	135	42	309	96
May Flower	122	47	279	107
Mammoth Pearl	131½	40	301	91
Alexander's Prolific	143	26	327	59
American Giant	105¼	18¼	241	42
E. Illinois	123	16	281	36
Garfield	99	30	226	68

It had been intended to boil samples of each variety, and to test as to quality for the table. This was done, but as some kinds had been touched by the rot, the report here given can not be considered as doing justice to all the varieties.

From the test we should rank them thus: Extra; Alexander's Prolific, E. Harvest and E. Sunrise. Fine; E. Ohio, White Star, E. Illinois, E. Maine and Garfield. Good; Crane's Potentate, Corliss Matchless and Rural Blush. Poor; Mammoth Pearl and American Giant.

These last being late growers, were probably injured for the table by not being fully matured, or tainted by the rot.

While all the potatoes dug as soon as the rot began to affect the tubers have kept well, those that were left undug for a couple of weeks rotted almost entirely, the White Star being the only partial exception.

The potato rot was so general over our state last fall that any information upon it, I am certain, will be of interest to our farmers.

The following very carefully prepared and concise statement of this disease, and preventive measures, was written by Mr. Erwin F. Smith, of the Botanical Laboratory, University of Michigan, and sent out in the Michigan Crop Report for December, 1885.

Nature of the Disease.

"The potato rot is a contagious disease which often spreads from plant to plant and field to field with great rapidity. The disease attacks the tops as well as the tubers, and is due, solely, or primarily at least, to the presence of a minute parasitic fungus, *Phytophthora infestans.* The life history of this parasite was carefully investigated many years since by De Bary and other botanists and is now well known. The destructive effects of the fungus are generally first observed upon the tubers late in the fall, but the disease is present much earlier in the season, and may be recognized on the tops by a certain characteristic blotched, black or brown spotted, dead appearance. A more critical inspection of the diseased tops would show numerous small, white spots scattered over the leaves and stems. When highly magnified these spots are found to be minature forests of slender stems growing up out of the surface of the leaves and stems of the potato. These tiny stems commonly branch and swell out at the ends into ellipsoid or oval bodies, known as summer spores. These little spores are produced by millions and are so small that a million could easily lie side by side on a square inch without crowding. When ripe they separate from the stem by a joint and fall. Under the influence of water the living, jelly-like contents of the spore may push out a long, slender tube, capable of growing down directly into any part of the potato plant to begin a new cycle of growth; or may separate into several distinct portions (swarm spores) which, being endowed with life and motion, burst through the wall of the mother spore, swim about actively for a few minutes, and then either die or thrust out a slender tube, capable, as in the other form, of becoming a mature plant inside of the potato plant. All this wonderful vital activity, so readily observed under the microscope, takes place, as we have seen, in bodies small enough to rest easily on the point of a pin and light enough to be readily blown from field to field.

The mature fungus lives in the tops or tubers of the potato, and is also a minute affair. Its presence can only be detected by the microscopist, but its capacity for mischief bears no relation to its size. It consists of very numerous, colorless, irregularly-branching, tube-like threads. These threads grow through the tissues of the potato more or less rapidly, appropriating to their own use the nutrient juices of the vegetable, and impoverishing its tissues so that they either break down directly or are invaded by bacteria and other low forms of life which induce putrifactive decomposition. It is this mature fungus which sends to the surface the white forest of tiny stalks bearing the summer spores already mentioned. These spores live only a short time, but the mycelium (the internal tube-like thread of the fungus) is perennial and hardy. There is little, if any, differentiation of parts or distinction of function in the internal portions of the fungus, and consequently, unlike the higher plants, a new plant may, under favoring conditions, arise from any least portion of it. In fact, any portion of it is a complete plant in itself, being capable of growth and reproduction.

It will be seen that the preventative measures are only aids to warding off the disease, and that nothing very potent is offered.

Since the terrible famine in Ireland, in 1847, caused by this fungus, England has tried to find some way to destroy it, or avoid its ill-effects, but though hundreds have came forward with remedies not one has been found successful under all circumstances.

There appears to be some hope of successfully combating this fungus, more than in the case of almost any others imilar plant parasite which is equally wide spread. The important facts to be considered in devising preventive measures are: (1) The fungus spreads from one plant to another during the growing season by summer spores, rain-washed or wind-blown; and (2) it depends, primarily, for its spread the following season upon its perennial mycelium (the tube-like threads) always to be found in the diseased tubers and tops. It may, also, possibly, grow from resting spores found in the same situations, although the existence of the latter is not settled beyond dispute.

Preventive Measures.

4. From what has been said it follows that the parasites may often live over winter in the tops and decaying tubers left in the fields after harvest. Prudence, would, therefore, dictate the complete removal and destruction of such refuse. It should be buried or burned. It should not be used for compost.

2. Store the harvested crop in *dry* cellars, and sort over several times at short intervals, carefully removing from the bins every tuber which shows the least sign of decay. Remove, also, to a separate pile, those tubers which have been lying in contact with the diseased ones. The sorting will be facilitated and the decay hindered by storing the tubers in casks, barrels or small boxes. Potatoes buried in

quantity in fields will be likely to rot *in toto* during the coming winter, if, by chance, any infected tubers were buried with the sound ones.

3. Plant next season only tubers which are entirely sound, outside *and inside.* The black spots contain the fungus. Some tubers may appear sound on the surface and be diseased within. Determine the soundness of the tubers by cutting at planting time. To plant diseased potatoes will insure a continuation of the rot.

4. Even if direction No. 1 has been followed, more or less of the potato fungus will probably remain over winter in the fields ready to grow if there is an opportunity. Do not, therefore plant in the same fields as last year, nor in adjoining ones, nor near fields planted by neighbors, if some more remote locality can be found.

5. Take advantage of the prevailing direction of the wind. Our summer and autumn winds are chiefly from points south and west. There is, therefore, a chance of escaping wind-blown spores by planting to the southwest of other potato fields, or to the north-east of woodland or other large uncultivated tracts.

6. The growth of the parasite is favored by moisture and stopped by drouth. It is rapid in rainy weather and when there are heavy dews. Usually the rot is much worse upon clay land or other soils which retain moisture. Choose, therefore, a light and dry soil for planting.

It has been shown experimentally that, with only moderate watering, the summer spores will penetrate the soil to a depth of several inches, consequently "hilling up" will not protect. The probabilities are, also, that no substances can be dusted upon or otherwise applied to the growing plants with much benefit. If some varieties of the potato are less subject to the rot than others, a thing not improbable, the present state of our knowledge does not enable us to say positively which they are."

INDIAN CORN.

To describe the various varieties of Indian corn so that they may be recognized by others, and to report correctly their relative values for Wisconsin will not be here attempted; the best that can be done is to present a few notes which may be of use to those who may be looking up varieties hoping to secure something better than they may now have. Despite the great care taken by many in saving seed, there is much corn through our state of the most mixed character, ranking with the good about as mongrel or scrub stock does compared with good grades or thoroughbreds. The needs of localities vary so greatly that many varieties will be required, taking the state as a whole, yet it does not lessen, but rather enhances the demand for a study of varieties and a careful examination into their several characteristics.

Along the shores of Lake Michigan and in all the northeastern half of the state only the flint varieties will as a rule succeed. All that part of the state lying below a line drawn from Osceola Mills, Polk county, to Kenosha county, will ordinarily ripen the dent varieties successfully. Strange as it may appear, about as large varieties of dent corn can be grown at River Falls as at Beloit.

The varieties here described were grown in small plats, side by side, all receiving the same treatment. Of course they mixed badly, but this would not affect this year's report, though it would make the saving of seed of no use. The corn was planted May 19th. The storm of July 8th and others following broke down so many of the stalks that no correct yield could be reported.

Mandan Indian, or Squaw Corn.

Stalks four feet high; ears placed on the stalks from six inches to one foot from the ground. Ears from 5 to 7 inches long, eight rowed medium cob. Mature August 15th. The grains of corn are red, white, blue, mottled, etc., often all these colors and shades being found on one ear. This corn was first planted as a curiosity; but the yield is fair, and if put in hills 2x3 feet, it is worthy of trial as a field crop in our northern counties.

French Yellow (*From France.*)

Ripe August 25th; stalks, five and one-half feet high; ears, 5 inches long; sixteen rowed, with large cob, resembles pop corn somewhat; not worthy of further trial.

White Pyrenean (*From France.*)

One week later than the previous named variety; somewhat better. Cob, six inches long; large grain, in fourteen rows, almost round; white. Of no possible value.

Chadwick.

Ripe September 1st; a very early yellow flint; eight rowed, with cob about eight inches in length, of small size Save the two previous varieties this is next to the Squaw or Mandan for earliness, and is worthy of trial in districts where early maturity is a prime requisite.

Winnebago White.

Ripe September 5th; ears, eight inches long; eight rowed; small cob; large pearly white grain. To those who prefer a white flint this variety would be suited in place of the Chadwick.

Longfellow.

An eight rowed yellow flint variety, ears 12 inches in length; has many suckers; ripened September 12. Apparently a large form of the Chadwick.

Silver Flint.

Six to eight feet high, growing much like dent corn. Scarcely ripe September 15. Ears 11–12 inches in length with a larger cob than the previous named valuable varieties As this variety is late growing there seems to be no special advantage in it unless one may prefer a flint to a dent variety, which is fully as early.

Pierce's Canada.

A yellow flint, ears eight inches long, sixteen rowed, with small, round grains. Ripe September 8th. Can see no special value in this variety.

Waushakum.

A yellow flint variety, growing six to seven feet high. Ripe September 10th. Ears from nine to ten inches long, eight rowed, cob very small and almost uniform size. A valuable variety.

Smut Nose.

Yellow grains, with those near the ends of the ear of purplish tinge. Ear ten inches long, medium sized cob. Of no particular value. Numerous varieties of corn, both yellow and white, having purplish or brownish markings toward the end of the ear are grown in the state under this name. Some of them are no doubt valuable.

King Philip.

This variety with us is one of the latest flints, ripening September 15th. Ears ten inches in length, eight rowed, grains very dark waxy yellow. An old standard variety, but of no apparent superiority in this trial. Probably our seed was not from the best strains.

Wisconsin White Dent.

Ripe September 15th; ears eight to ten inches long; sixteen rowed; grain of medium length; rather large cob. Rather too large a growing variety for this section.

North Star Golden Dent.

A fine yellow dent corn — one of the very best, but sometimes very common seed corn is sold under this name. The true variety has a deep kernel, red cob which is somewhat flattened; ears about eight inches long, 14 to 18 rowed. Well grained over tip of the cob and at the base. An excellent corn for Wisconsin.

Pride of the North.

A small variety of yellow dent, but very prolific. Cobs very small, about fourteen rowed. Ears tapering, and of so few rows that they are not large. The rows of grain are often placed irregularly on the cobs. One would not at first appreciate the merits of this variety. Only by studying the good yield and the large weight of sound grain from a bushel of ears will the full of merits be seen. It is an early variety, though with us not ripe this year until September 15th; stalks small, seven feet in height.

Badger Yellow Dent.

Stalks seven feet high, well eared; ears seven to nine inches long, from sixteen to twenty-two rowed. Medium cob and deep grain. A good variety when one wishes corn of the shoe-peg type.

Premature Millo-Maize.

The following letter in relation to a new fodder plant at the South was received, together with the package of seed mentioned:

MARIETTA, Ga., April 13, 1885.

Prof. W. A. HENRY,
Experimental Farm, Madison, Wis.

DEAR SIR — I have taken the liberty of sending you one-half a pound of Premature Millo-Maize seed.

In 1881, I procured seed from the original seed-head, brought from the United States of Columbia, by the Rev. H. B. Pratt. My experience with the plant is stated in the enclosed paper. I can now more confidently affirm the feed value of the cane, as I continued its exclusive use as roughness until March 30th, when they gave out.

As the plant has reduced its season fifteen days in each year, from the eight months originally required for maturing seeds here, I believe these sent you will mature a crop in your locality. They mature in about four months.

The plant's capacity to withstand drouth is established, and I should be pleased to have you try these seed.

For a forage I lay stress upon what I term the Zulu-plan, viz: keeping the seed-heads from fully forming, by plucking them off, until about three weeks before frost; then stripping all the leaves, cutting the tops and small suckers, binding them in bundles and curing them in the usual way for fodder, and a week or ten days later cut the canes and house them for winter stock feed.

Please plant in rich soil and not until the ground is thoroughly warmed.

Very Respectfully Yours, etc..
G. W. BENSON.

I should be much obliged to know the result, if you try the seed this season.
G. W. B.

The seed was planted and treated in all respects as a crop of Amber cane would have been. The plants grew much as corn does, but throw up more suckers and produces many leaves. It showed no signs of producing seed heads in the fall when threatening frost forced us to cut the crop. One thousand five hundred and forty-seven square feet of ground produced four hundred and fifty-four pounds of fodder about as dry as usual for such fodders. This is at the rate of over twelve thousand pounds of fodder per acre.

We found upon weighing that fifty dried stalks stripped of the leaves weighed six and one-fourth pounds, and the leaves from these stalks weighed two and one-half pounds. Fifty amber cane stalks cut and shocked for fodder in the same way gave thirty-three pounds of stalks and five pounds of leaves.

By drying at 212° it was found that this fodder contained 48.26 per cent. of dry matter. No analysis of this fodder was made.

It seems plain that we are too far north to grow this fodder to advantage, but it has value and is worthy of careful trial further south, say in Kansas, where fodders of this character are highly prized as food for stock. In such climate and soil Millo-maize should prove valuable.

REPORT ON GRASSES AND FORAGE PLANTS.

By W. A. HENRY.

In the spring of 1884, a large number of varieties of grass and forage plant seeds were grown under direction of the Professor of Botany. These were sown in beds four feet wide by fifteen feet in length, surrounded by paths. The idea was to test the merits of the several varieties as to hardiness and other qualities and to present to the public an opportunity to learn by observation and comparison, to distinguish the various species. It must be admitted by all, that considering the great usefulness of the grass family, we as a people are grossly ignorant of all but a few of the more common species. These beds of grasses have been inspected by a large number of people visiting the farm, many giving only a casual glance at each bed, but others, and not a few, have spent some little time in looking at the different species and comparing them. The present season, the beds will be moved to a more favorable location and the plan continued. In addition to these small beds of grasses and forage plants, larger areas of one-tenth of an acre each have been sown with the seeds of such varieties, singly and in combination as we hope may prove of value agriculturally; the plots occupy two acres of land.

While the small plots before mentioned are directly under the charge of the Professor of Botany, I have taken the liberty to write out at this time a few notes upon the appearance of the several beds and the possible value of some of the species for agricultural purposes, believing that there are many who will be interested in the subject.

The following notes were taken May 6, 1886, and show the growth and condition of the several species at that date with remarks upon the quality of the herbage, etc. It should be noted that the season of 1886 is, with us, fully twelve days ahead of the ordinary years.

1. Timothy, *Phleum pratense.*

Bed sown in 1884; has stood the winters well. Largest leaves, 18 inches; average leaves 10 inches. Plants leafy and offers much food at this date. This excellent grass is too well known to need further comment.

2. Fowl Meadow, *Poa serotina.*

Bed sown in 1885; has stood the winter well. Largest leaves, 10 inches; average leaves, 8 inches. Plants fine and leafy; apparenly one of the best for pastures at this date.

3. Blue grass, *Poa pretensis.*

Bed sown in 1884; plants perfectly hardy. Largest leaves 9 inches; average leaves 7 inches. This is the commonest grass in Wisconsin, and one that, though almost every farmer in the state is familiar with it, many are still in doubts as to its correct name. What our Wisconsin farmers know by the various names of June grass, Blue grass and Kentucky Blue grass are all one and the same. Over a large part of the state at least, if not all, except where very sandy, this plant makes its way persistently and occupies the roadsides and old pastures almost to the exclusion of all other varieties. It affords excellent pasture of fine, soft, nutritious grass until the latter part of July, when for six weeks it grows but slowly, having more or less exhausted itself. It is not able to withstand drouth very well, and in dry seasons often becomes so brown that one supposes it dead. With the fall rains it starts up again and affords a good bite until severe frosts. A Blue grass sod is very dense and improves with age. To this grass Wisconsin owes much of its reputation as a dairy state. It is the most valuable in the whole list for lawns as it makes by the addition of a little White clover and Red Top a smooth, green carpet of even growth, and is green close to the earth.

3. Red Top, *Agrostis vulgaris.*

Sown in 1884; hardy; largest leaves, 7 inches; average leaves, 4 inches. Later in starting than Blue grass and with much less dense foliage. This grass is valuable on ground somewhat damp, where it makes a hay of good quality and affords good pasture.

4. Bent grass, *Agrostis stolonifera.*

Sown in 1884; hardy; largest leaves, 9 inches; average leaves, 8 inches. Seemingly a better pasture grass than its relative mentioned above. At this date it has a sod almost equal in density to Blue grass, and shows a fine carpet of grass.

5. White Bent grass, *Agrostis alba.*

Sown in 1884; hardy; length of longest leaves, 7 inches; average leaves, 4 inches. Seems to be much inferior to its relative, the Bent grass.

6. Orchard grass, *Dactylis glomerata.*

Sown in 1884; not so hardy as could be wished, yet this variety is said to grow as far north as Alaska. Length of largest leaves, 19 inches; average length of leaves, 12 inches. Here is a grass that our Wisconsin farmers can no longer afford to neglect. As a meadow grass it is probably inferior to Timothy, but since it comes in head a couple of weeks earlier than that variety, it naturally mates well with Red clover, as the Orchard grass is ready for the mower as soon as the clover.

It grows about as tall as Timothy. The great value of this species, however, lies in its qualities as a pasture grass. Among its good qualities may be stated: It is a very early, succulent grass, with leaves averaging twelve inches in length on the sixth of May. It grows until late in the fall. It shoots up rapidly after being cropped, often growing an inch a day in favorable weather, when not exhausted, and grows well in partially shaded ground, hence its name, Orchard grass. Its disadvantages are that it grows in tufts unless sown very thick. For lawns it is the poorest grass that can be sown, since it grows so much more rapidly than other grass that when mowed it springs up at once, overtopping all other varieties, giving the lawn a ragged appearance. Many who do not know it may recognize it from this habit. It should never be sown alone for pasture but with other varieties, so that its habit of growing in stools or tussocks will cause no loss of pasture, all the intermediate space being occupied by the other varieties. Although it has been partially killed out in some instances by severe winters I deem it fully as hardy as Red clover, which all will continue to sow despite an occasional loss. This grass will be mentioned again in speaking of pastures.

7. Tall Fescue, *Festuca elatior.*

Sown in 1884. Has not stood very well in the bed by itself. Tallest leaves, 18 inches. Average leaves, 11 inches. In many respects this resembles Orchard grass, but our experience is too limited to speak with any positiveness of its qualities.

8. Hard Fescue, *Festcua duriuscula.*

Worthless in the presence of so many better varieties.

9. Sheep's Fescue *Festuca ovina.*

Valuless on any soil worthy of cultivation.

10. Hair Grass, *Aira cæspitosa.*

Grows in tufts affording a foliage of stiff leaves unfit for pasture or hay.

11. Meadow Foxtail, *Alopecurus pratensis.*

Sown in 1884; does not stand well when grown by itself. Tallest leaves, 18 inches; average leaves, 11 inches. This grass seems worthy of careful study. In habit it resembles Timothy, having a head closely resembling that of the latter plant, but it does not grow so tall, and is more leafy. It is very early, many heads being in sight at this date. This quality of extreme earliness added to the large amount of soft, tender foliage should commend this grass to those looking for additions to our list of pasture grasses. We shall experiment with it on larger areas, hoping for good results.

Quack Grass, *Triticum repens.*

Sown in 1884; of course, like all pests, perfectly hardy. Tallest leaves, 12 inches; average leaves, 8 inches.

This is a grass of considerable value for pastures, but its persistency of life in cultivated fields is so great that it should be avoided with the same care that we guard against Canada thistles. The plant multiplies by its seed, and also its long creeping root stalks. When land on which this grass occurs is broken up, their long creeping stems are dragged up by the harrow teeth and distributed over the field, each joint is capable of developing into a plant, and so it can soon occupy a whole farm.

Where it has once gained a foothold, it can only be eradicated by planting the land to some crop like potatoes, and then by plowing and hoeing it repeatedly keeping the ground absolutely clean. Only by such treatment, persistently adhered to, can an infested farm be cleared from the pest. Summer following the land plowing so often that nothing green appears from spring to fall, and then following with a hoed crop, may be the best way for farmers who cannot successfully carry out the first plan. This most pernicious is often carried to farms by adhering to the roots of fruit trees or other plants shipped from infested nurseries.

Paspalum dilatatum.

Mr. Chas. N. Eley, of Smith's Point, Texas, kindly sent to the Station in August, 1885, half a dozen roots of this variety of pasture grass for trial. The following is a description of its merits as given by Mr. Eley:

"A perennial evergreen pasture and forage grass, growing during the longest drouths; will stand heavy grazing. If closely pastured, it spreads itself by underground roots, forming a solid turf and abundance of fresh shoots. If protected from stock it grows two or three feet high, giving repeated cuttings of hay. It is best propagated by sets or roots. Seed is unreliable and not recommended. Each set or stole will multiply itself by suckers or shoots, forming stools or tufts. Seed stalks grow 5 to 7 feet high, and falling to the ground, scatter the seed, and each joint of seed-stalk forms roots through the surrounding grass. In this manner it excludes all other grasses — circumstances, of course, govern the time required. When first planted it should be protected from stock or they will pull it up if grazing upon it before it becomes rooted. One set or root to every square yard is close enough to plant it."

The roots were planted out upon arrival, and made quite a little growth. However, the winter proved too much for them and none survived. This result was feared by Mr. Eley who has promised to send more roots this spring. These will get a better start and be better prepared for the winter. Whether such a grass can survive our climate is questionable, but it is worthy of trial.

The grasses in four beds have died out so badly that it is impossible to report upon them. These were Italian Rye, *Lolium Italicum;* English Rye, *Lolium perenne;* Fall Oat, *Avena elatior,* and Yellow Oat, *Avena flavescens.* These grasses which are said to be very valuable when growing in company with others, and are highly prized in England, have done very poorly with us growing separately. We shall try them in mixtures in the future.

Alsike Clover, *Trifolium hybridum.*

Bed sown in 1885; as hardy as Red clover. Tallest leaves, ten inches; average leaves, eight inches. Fine and leafy. Has most of the good qualities of common Red clover but is more straggling in growth, and consequently does not stand up so well. The sweet scented pinkish blossoms afford much nectar for bees. This plant resembles the Red clover so closely in general qualities that it probably never will become very common in our list of agricultural plants, as our farmers do not feel any especial need for it. Sown with Timothy which helps hold it up, it makes good hay. Of its qualities for pasture I will speak further on.

Red Clover, *Trifolium pratense.*

Sown in 1885; generally hardy though we have had it freeze out once in six years' experience. Tallest leaves, six inches; averag leaves, four inches. Leafy, and affords considerable pasture at this date. This most valuable plant is too well known and appreciated by progressive farmers to need further comment.

White Clover, *Trifolium repens.*

Sown 1884; hardy. Tallest leaves, six inches; average leaves, four inches. This plant affords considerable pasture at date. It is the companion of blue grass and omnipresent in this state. The rapidity with which it spreads is a puzzle to many. This is accomplished in general by two methods. The seed heads are cropped by stock and the seeds uninjured appear in the excrement. This scatters the plants over large areas. It has been noticed that the ripened clover head breaks from the supporting stem and is blown about by the wind, rolling over and over on the ground carrying its freight of seeds with it. This plant is a great nuisance in gardens, but of considerable value in pastures.

Bockhara Clover, Sweet Clover, *Melilotus alba.*

Sown in 1885; hardy; tallest stems, 15 inches; average height of foliage, 12 inches. This plant is occasionally grown for its medicinal value and is seen as a weed along roadsides to which it has escaped from gardens. When fully grown the stems are woody, coarse and of no value for any purpose. In early growth, however, the plant is very leafy and succulent. The rapid growth in early spring of soft, succulent leaves and stems seems to point out that this plant may be of value in supplying a very early soiling crop. We are sadly in need of just such a plant and shall study this one on larger areas and under diverse conditions, with the hope that it may supply the want mentioned.

Alfalfa, *Medicago sativa.*

This plant makes remarkable growths and furnishes an immense amount of hay in Colorado, California and other localities where soil and climate are favorable. It succeeds only on dry, deep soils and furnishes the large crops reported only where it can be irrigated.

The reports of large yields at the West have excited the interest of many people at the East, who have hoped to secure like results.

With us, sown on a clay loam, the plant grew fairly well two seasons, living over one winter. Last winter, however, killed out all the plants but one or two, which now show a weak growth. I doubt if this plant will succeed any place in Wisconsin, for if soil is favorable the climate is not. Our farmers, who pay large prices for the seed will, without doubt, get no returns for their efforts. We had better content ourselves with Red clover for the present and endeavor to get a good even growth of this wonderful plant which is so remarkably adapted to our system of rotation farming.

GRASSES FOR PERMANENT PASTURE.

In the second report of the Station, pages 29-31, an account was given of sowing a number of grasses and clovers in the spring of 1884, upon a lot of about four acres in area, with the hope that a superior pasture would be secured.

The results of the first season as there reported were very satisfactory, but time is needed in all such trials before any real facts can be brought out.

In the article referred to it is stated that the following varieties and amounts of seeds were sown:

Grasses.	*Per acre.*
Timothy	7 pounds.
Orchard	4 pounds.
Italian Rye	2 pounds.
Perennial Rye	2 pounds.
Tall Oat	2 pounds.
Red Top	2 pounds.
Kentucky Blue	2 pounds.
Clovers.	
Alfalfa	4 pounds.
White	1 pound.
Alsike	1 pound.
Red	2 pounds.

The winter of 1884-5 proved a most disastrous one with us, as during the later part of the season a solid body of ice formed over large areas of the fields and smothered all but the hardiest plants. Winter wheat and Red clover suffered most severely, and on large patches of our field of mixed grasses every variety was killed out but White clover. The pasture has not yet recovered from this disaster altogether. Where snow lay on the ground and ice did not form we have a fine stand of mixed grasses, and the stock shows proper appreciation of them.

As the writer is unable to distinguish accurately each species sown by the short-cropped leaves that appear at this writing, it is impossible to state just how the several varieties have held their own where they have had a fair chance to grow.

Our experience with this and a second pasture, the latter an open woods where the seeds were sown on unplowed ground and brushed in, warrants our saying that Orchard grass at least should be more freely used for pastures by our farmers than it now is. It can be sown in any amount up to a bushel and a half per acre with other grasses. Its extremely rapid growth and earliness make it a valuable supplement to Blue grass, Timothy and Red clover. It grows excellently well in partial shade, and so is valuable for most pastures. With the clovers the task of reporting is easy; Red clover has disappeared until less than half the plants of the first season appear. Alfalfa has proved of no value from the start. It is strongly doubted from observations made, whether this plant is of the least value in our state. The few plants of this variety that survive in this pasture are spindling and afford but little food.

It is remarkable how well the Alsike clover has stood, there being apparently as many plants now as any previous time. The plants are leafy, and must be a valuable addition. This experience warrants us in urging that our farmers try this plant for pasture purposes, along with a mixture of other clovers and grasses. It would seem that it is not properly appreciated.

TESTS OF MACHINERY, ETC.

By W. A. HENRY.

On pages 41–43 of our second report are given some account of our twenty foot geared Eclipse wind mill, Since the trials reported we have made a few more which are here given. The tests as reported serve to give some idea of the power of the wind mill and also the capacity of the machinery driven by it.

THE LION FEED CUTTER.

On November 3, 1885, with a wind recorded at the Washburn Observatory as blowing 20 miles per hour, we cut and crushed in one trial, 500 pounds of mammoth fodder corn, ears and all in 21 minutes; in a second trial 500 pounds were cut and crushed in 19 minutes; average of the trials 20 minutes or 1,500 pounds per hour. With this mammoth fodder and the large half ripe ears that grew on the stalks we have the most difficult work to which this machine could be put. This cutter not only cuts but crushes all the coarser parts of the fodder, including ears of corn, until they are so reduced that they are eaten by stock without difficulty.

On the same date 306 pounds of ripe yellow dent unhusked cornstalks were put through the same cutter in 13 minutes. The corn was all shelled from the cobs, and the cobs ground until with few exceptions the pieces were scarcely larger than grains of corn. On April 16, with a wind blowing 25 miles per hour, according to the Observatory report, this feed cutter, cut and crushed 100 pounds of mammoth fodder corn stalks in four minutes, or at the rate of 1,500 pounds per hour. The cuts were three-fourths of an inch in length and the fodder and soft ears well crushed.

THE BELLE CITY FEED CUTTER.

On April 16, a trial was made with this cutter, which simply cuts the cornstalks off squarely. With the same wind as just reported, 25 miles per hour, we cut into three-fourth inch lengths, 100 pounds of mammoth fodder corn in two and a half minutes, or 2,400 pounds per hour. This is a very fair statement of the capacity of the machine with mammoth fodder on which were many full sized heavy half ripe ears of corn. This is a very strong well made cutter.

WOOD SAWING.

After testing the two cutters the wind still being of about the same power the belt was changed to the circular wood saw and two men sawed half a cord of body oak wood twice in two in 15 minutes. These three tests made under the same conditions, give a good idea of the power of the wind mill and the relative amount of power required for the several machines.

THE DIAMOND FEED MILL.

In the report referred to it was stated that we had not been successful in grinding feed. Since that time we have put in a Diamond "Pony" iron feed mill, made by McLoughlin & Sheldon, Owatonna, Minn., which has proved very satisfactory. In a trial with a high wind and new grinding plates, corn was ground reasonably fine at the rate of 30 bushels per hour. With ordinary winds we can grind from eight to twelve bushels per hour, the grain feeding into the grinding plates evenly and the mill working almost noiselessly. We shall make further tests, but so far are much pleased with this grinder.

THE STROWBRIDGE BROADCAST SEEDER.

This seeder was sent to the farm to be tested by C. W. Dorr, secretary of the Strowbridge Seeder Co., Des Moines, Iowa.

The machine is attached to the end-gate of a wagon, and scatters the seed by a revolving spindle, driven by a sprocket chain running over a band attached to one of the hind wheels. A test showed grain to be thrown the following distances when the team was on a fair walk:

Buckwheat	38 feet.
Barley	38 feet.
Wheat	35 feet.
Oats	28 feet.
Millet	27 feet.

Up to this width the grain was scattered quite evenly; outside these wide paths some scattered grain fell but these figures represent the widths of proper spread seed.

In a windy day the seeds would be blown somewhat from their proper course.

THE PURINTON FEED STEAMER.

We have found this steamer satisfactory for the purposes intended. It is low priced and with good usage seemingly fairly durable. Steam can be raised in twenty minutes and conveyed to barrels of feed or water, either for heating or cooking. By covering a barrel of potatoes with bran and introducing steam at the bottom, the potatoes were cooked soft in thirty-three minutes.

THE GILT-EDGE BUTTER WORKER.

This butter worker is made by the Racine Refrigerator Co., Racine, Wis. Our trials have shown it satisfactory, and with a little practice in handling it does good work. It consists of a flat bottomed box with low sides; into this box fits a cover moved by a lever-like handle. The butter is pressed flat by bringing down the cover and folded with a couple of paddles in the hands of the operator for the next flattening. Properly worked it should do little harm to the grain of the butter, and soon prepare it for packing.

FEEDING STANDARDS AND COMPOSITION OF FEEDING STUFFS.

By H. P. ARMSBY.

A large amount of work has been done under my direction during the past year in the analysis of feeding stuffs, and the study of the relations which can be traced between the chemical composition of cattle foods and their nutritive effect as shown by feeding trials. A brief explanation of some of the terms used in fodder analysis, and of the present state of our knowledge upon the science of feeding, will, perhaps, conduce to a better understanding of the results presented on subsequent pages.

The body of an animal consists mainly of four classes of substances, viz.:

1. Water; which makes up from 40 to 60 per cent. of the weight of the live animal, and is just as essential a part of its tissues as any other ingredient.

2. Ash, or mineral matters; amounting to from 2 to 5 per cent. of the weight and constituting a considerable proportion of the bones and a smaller proportion of the soft tissues.

3. Fat; varying greatly in amount according to the condition of the animal, but seldom falling below 6 per cent. or rising above 30 per cent.

4. Protein; a name given to an important group of substances, of which washed lean meat or the white of egg may be taken as the type. They all contain about 16 per cent. of the element nitrogen, which is entirely lacking in the three other groups, and are remarkably alike in their general properties. The organic part of the bones, the ligaments, tendons and muscles which bind together and move the bones, the skin, the internal organs, the brain and nerves, in short, all the working machinery of the body, are composed very largely of protein. Consequently this group of substances is of great importance, and a due supply of it in the food, particularly to growing animals, is indispensable.

The following table shows more in detail the average chemical composition of different animals, in different stages of fatness.

Average Composition of Live Animal.

	Ox.			Calf.	Sheep.					Swine.	
	Well fed.	Half fat.	Fat.	Fat.	Lean.	Well fed.	Half fat.	Fat.	Very fat.	Well fed.	Fat.
Water	66.2	59.0	49.5	64.6	67.5	63.2	58.9	50.9	43.8	57.9	48.9
Ash	5.9	5.2	4.4	4.8	4.0	3.9	3.8	3.3	3.1	2.9	1.9
Fat	8.7	17.5	30.5	14.1	10.2	15.5	21.3	31.9	41.4	24.2	42.3
Protein	19.2	18.3	15.6	16.5	18.3	17.4	16.0	13.9	12.2	15.0	11.9
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

In the food of the animal, we find the same four groups of substances which we do in the body of the animal, viz., water, ash, fat and protein, and in addition large quantities of a class of bodies called carbhydrates. Starch, sugar and woody fiber are the commonest representatives of this class. They contain no nitrogen. With the exception of the woody fiber they are readily digested.

What purpose, now, do these ingredients of the food serve in the animal economy? To simplify matters, we may leave out of account the water and ash. The chief supply of water to the animal is in its drink, and we do not employ fodder for the sake of its water. The ash is essential to the well-being of the animal, but any reasonably sufficient ration will abundantly supply the small amount required by the body. There remain to be considered tho protein, fat, and carbhydrates. The protein of its food is used by the animal to supply the wear and tear of its working machinery, which, as above stated, is largely composed of this substance; to supply the material for growth in the case of young animals; for the production of wool in sheep; and for the casein of the milk in milking animals. For these purposes it is absolutely indispensable. No other substance can be worked over into protein by the body. The amount of protein which the ration must contain will vary with the nature of the animal to which it is fed, but a certain minimum amount is always necessary.

The fat and carbhydrates of the food serve two purposes in the animal economy. First, they are burned as fuel to keep the animal warm, and to supply the force necessary for its internal and external motions. For this purpose a pound of fat is about 2.2 times as valuable as a pound of carbhydrates. Second, the carbhydrates and fat serve as sources of fat. Their relative value in this respect has not been determined, but it is not improbable that it is about the same as for the production of heat. Finally, when more protein is fed than is needed for growth and repair, this also is utilized as fuel or as fat forming material. For fuel it is worth about 1.1 times as much as the carbhydrates, as a fat producer less than six-tenths as much. An unnecessary use of protein for fuel or fattening, however, is not usually economical, because it is commonly the most expensive ingredient of the food to produce or buy.

In view of these considerations, it is plain that, in feeding for different purposes, different amounts and proportions of digestible protein, carbhydrates and fat will be required in the ration. The attempt has been made to formulate in what are called feeding standards, the requirments of various kinds of animals in this respect, and Wolff's standards in particular have been widely circulated in this country, and have been the subject or no little discussion. They are as follows:

FEEDING STANDARDS.

A.—Per Day and per 1,000 *lbs. Live Weight.*

		Total organic substance.	Nutritive (digestible) substances.			Total nutritive substance.	Nutritive ratio.
			Protein.	Carb-hydrates.	Fat.		
		lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
1. Oxen at rest in a stall		17.5	0.7	8.0	0.15	8.85	1 : 12.
2. Wool sheep, coarser breeds		20.0	1.2	10.3	0.20	11.70	1 : 9.
Wool sheep, finer breeds		22.5	1.5	11.4	0.25	13.15	1 : 8.
3. Oxen moderately worked		24.0	1.6	11.3	0.30	13.20	1 : 7.5
Oxen heavily worked		26.0	2.4	13.2	0.50	16.10	1 : 6.
4. Horses moderately worked		22.5	1.8	11.2	0.60	13.60	1 : 7.0
Horses heavily worked		25.5	2.8	13.4	0.80	17.00	1 : 5.5
5. Milk cows		24.0	2.5	12.5	0.40	15.40	1 : 5.4
6. Fattening oxen, 1st period		27.0	2.5	15.0	0.50	18.00	1 : 6.5
Fattening oxen, 2d period		26.0	3.0	14.8	0.70	18.50	1 : 5.5
Fattening oxen, 3d period		25.0	2.7	14.8	0.60	18.10	1 : 6.0
7. Fattening sheep, 1st period		26.0	3.0	15.2	0.50	18.70	1 : 5.5
Fattening sheep, 2d period		25.0	3.5	14.4	0.60	18.50	1 : 4.5
8. Fattening swine, 1st period		36.0	5.0	27.2		32.50	1 : 5.5
Fattening swine, 2d period		31.0	4.0	24.0		28.00	1 : 6.0
Fattening swine, 3d period		23.5	2.7	17.5		20.20	1 : 6.5
9. Growing cattle:							
Age, Months.	*Average live weight, per head.*						
2—3	150 lbs	22.0	4.0	13.8	2.0	19.8	1 : 4.7
3—6	300 lbs	23.4	3.2	13.5	1.0	17.7	1 : 5.0
6—12	500 lbs	24.0	2.5	13.5	0.6	16.6	1 : 6.0
12—18	700 lbs	24.0	2.0	13.0	0.4	15.4	1 : 7.0
18—24	850 lbs	24.0	1.6	12.0	0.3	13.9	1 : 8.0
10. Growing sheep:							
5—6	56 lbs	28.0	3.2	15.6	0.8	19.6	1 : 5.5
6—8	67 lbs	25.0	2.7	13.3	0.6	16.6	1 : 5.5
8—11	75 lbs	23.0	2.1	11.4	0.5	14.0	1 : 6.0
11—15	82 lbs	22.5	1.7	10.9	0.4	13.0	1 : 7.0
15—20	85 lbs	22.0	1.4	10.4	0.3	12.1	1 : 8.0
11. Growing fat pigs:							
2—3	50 lbs	42.0	7.5	30.0		37.5	1 : 4.0
3—5	100 lbs	31.0	5.0	25.0		30.0	1 : 5.0
5—6	125 lbs	31.5	4.3	23.7		28.0	1 : 5.5
6—8	170 lbs	27.0	3.4	20.4		23.8	1 : 6.0
8—12	250 lbs	21.0	2.5	16.2		18.7	1 : 6.5

B.—Per Day and per Head.

		Total organic substance.	Nutritive (digestible) substances.			Total nutritive substance.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.		
Growing cattle:							
Age. Months.	*Average live weight, per head.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	
2—3	150 lbs	3.3	0.6	2.1	0.30	3.00	1:4.7
3—6	300 lbs	7.0	1.0	4.1	0.30	5.40	1:5.0
6—12	500 lbs	12.0	1.3	6.8	0.30	8.40	1:6.0
12—18	700 lbs	16.8	1.4	9.1	0.28	10.78	1:7.0
18—24	850 lbs	20.4	1.4	10.3	0.26	11.96	1:8.0
Growing sheep:							
5—6	56 lbs	1.6	0.18	0.87	0.045	1.095	1:5.5
6—8	67 lbs	1.7	0.17	0.85	0.040	1.060	1:5.5
8—11	75 lbs	1.7	0.16	0.85	0.037	1.047	1:6.0
11—15	82 lbs	1.8	0.14	0.89	0.032	1.062	1.7.0
15—20	85 lbs	1.9	0.12	0.88	0.025	1.047	1:8.0
Growing fat swine:							
2—3	50 lbs	2.1	0.38	1.50		1.88	1:4.0
3—5	100 lbs	3.4	0.50	2.50		3.00	1:5.0
5—6	125 lbs	3.9	0.54	2.96		3.50	1:5.5
6—8	170 lbs	4.6	0.58	3.47		4.05	1:6.0
8—12	250 lbs	5.2	0.62	4.05		4.67	1:6.5

"Total organic matter" signifies the combustible portion of the ration, free from water and ash. The difference between "total organic matter" and "total nutritive substance" shows the amount of indigestible matter in the ration and thus indicates something as to its proper bulk. The "nutritive ratio" is the ratio of digestible protein to the sum of the digestible carbhydrates and fat. For animals weighing more or less than 1,000 pounds, the quantities are to be increased or diminished in proportion to the weight.

In using one of these standards we endeavor to fix upon a mixture of feeding stuffs which shall contain in a reasonable bulk the amounts of digestible matters called for by the standard. To do this we need to know how much digestible matter the fodders which we are to use contain. The following table shows the average composition and content of digestible matters of some common fodders. The composition of the fodders is taken chiefly from Dr. E. H. Jenkins' compilation of American analyses in the report of the Connecticut Agricultural Experiment Station for 1885; the digestibility is computed from the results of German experiments.

AVERAGE COMPOSITION OF FEEDING STUFFS.

	Number of analyses.	PERCENTAGE COMPOSITION.						PER CENT. OF DIGESTIBLE MATTER.		
		Water.	Ash.	Protein.	Crude fiber.	Nitrogen free extract.	Fat.	Protein.	Carbhydrates.	Fat.
Corn ensilage	47	80.59	1 37	1.49	5.82	10.05	0.69	1.09	10.35	0.52
Clover ensilage	2	75 58	2 83	3 40	7.43	9.76	1.02	2.24	11.06	0 65
Clover hay	13	14.65	5.33	11.44	26.69	39 87	2.02	6.29	37.95	1.03
Timothy hay	32	11 19	3 98	6.02	30.35	46.26	2.20	3 07	43.22	0.90
Mix'd meadow grasses	2	14.80	4 39	6 76	26.85	46.16	1.53	3.85	44.19	0.73
Corn fodder—field cured	6	52 05	4 32	4.29	22.14	35.96	1.24	2 45	35.14	0.60
Oat straw	3	10.11	4.72	3.35	42.78	36 97	2.07	1.43	42 67	0.62
Rye straw	2	11.11	1.84	4.54	38.75	38.37	1.84	0 95	37.45	0 59
Wheat straw	1	6.50	6.96	4 98	38 08	41.99	1.49	0.85	37.69	0.85
Mangolds	3	92.04	1.05	1.71	0 82	4.18	0.20	1.30	3.97	......
Rutabagas	1	87.08	1 41	1.15	1.16	9.11	0.09	0.66	8.11	......
Turnips	1	88.89	0.71	1.34	0.86	8 11	0 09	0.76	7.22	......
Potatoes	5	78.55	0.86	1.95	0.56	17 99	0.09	1.42	17.94	......
Peas	...	13.20	2.40	22.40	6.40	52 60	3.00	19 71	55.04	1.50
Barley	9	10.92	2 38	12.39	2.57	69.88	1.86	9 66	62 00	1.67
Oats	21	10.70	3.00	11.30	9.00	61.00	5.00	9.72	48.50	3 90
Rye	6	11.60	1.90	10.60	1 60	72.60	1.70	8.48	58.40	1.58
Wheat	307	10.55	1.83	11.86	1.79	71.87	2.10	9 49	60.85	1 89
Corn	184	10 54	1.55	10.59	2.10	69 73	5.49	9.11	67.08	4.17
Sorghum seed	9	12 52	1.80	8.88	1.88	71.27	3 65	7.63	68 46	2.77
Brewers' grain	15	75.00	1.01	5 57	3 87	12 87	1 68	4.07	9 75	1.41
Malt sprouts	3	10.27	5 67	22.95	10.72	48.60	1.79	18.82	48.13	0.88
Cotton seed meal	24	8.33	7.25	42.06	5.69	23.43	13.24	35 75	22.25	11.65
Oil meal—old process	4	8.34	5.99	30.80	10.00	34.75	10.12	25.87	32.20	9.11
Oil meal—new process	12	10 12	5 93	32.94	9.09	38 35	3.57	27.67	31.68	3 25
Rye bran	3	12 30	3.62	15.26	3.51	63.12	2.19	10.07	47.48	1.27
Wheat bran from roller mills	5	12.00	6.08	15.42	8.59	53.49	4 42	12.03	44 02	3 05
Wheat bran—old process	9	12.00	4.92	13.02	8.12	58.18	3.76	10.16	47.48	2 59
Wheat shorts	6	11.85	4.32	13.14	7.94	58 96	3.79	10.25	28.02	2 62
Gluten meal	6	9.30	0.75	29.62	1.54	53.10	5.69	25.47	37.80	4.32

As an illustration of the manner in which these tables of feeding standards and of the composition of feeding stuffs are intended to be used, we may compute a ration for a milch cow weighing 1,000 pounds.

As the foundation for a ration, let us take 20 pounds of corn ensilage and 10 pounds of clover hay. The first step is to estimate how much digestible matter these will furnish. According to our table, average ensilage contains 80.59 per cent. of water and 1.37 per cent. of ash, and consequently 100–80.59–1.37=18.04 per cent. of dry organic matter, together with 1.09 per cent. of digestible protein, 10.95 per cent. of digestible carbhydrates, and 0.52 per cent. of digestible fat. Twenty pounds of it would therefore contain 3.61

pounds of total organic matter; 0.22 pounds of digestible protein; 2.19 pounds of digestible carbhydrates; 0.10 pounds of digestible fat.

In the same way we estimate the amount of organic matter and of digestible substances contained in ten pounds of clover hay, and we find that the coarse fodder of the proposed ration furnishes the following amount of nutritive matters:

	Organic Matter.	DIGESTIBLE		
		Protein.	Carbhydrates.	Fat.
	lbs.	*lbs.*	*lbs.*	*lbs.*
20 lbs. of ensilage	3.61	0.22	2.19	0.10
10 lbs. of clover hay	8.00	0.63	3.80	0.10
Total	11.61	0.85	5.99	0.20

This naturally falls considerably short of the standard, and the deficiency must be made up with grain or meal of some sort. The market price will usually be an important factor in deciding what kinds shall be used. We will suppose, however, that a mixture of corn meal and bran has been fixed upon: what amounts of each shall we take to complete the ration? This we must find by trial. We start with, say, five pounds of each, and calculate from the table how much digestible matter they will supply. Having done this our table stands as follows:

	Organic Matter.	Digestible.		
		Pro-tein.	Carbhy-drates.	Fat.
	lbs	*lbs*	*lbs.*	*lbs.*
20 lbs., of ensilage	3.61	0.22	2.19	0.10
10 lbs., of clover hay	8.00	0.63	3.80	0.10
5 lbs., of corn meal	4.40	0.46	3.35	0.21
5 lbs., of bran	4.09	0.61	2.21	0.16
Total	20.10	1.92	11.55	0.57

The ration still falls short of the standard. Before increasing the quantity of bran or meal, however, let us see exactly what is lacking. We need still 0.58 pounds of protein and 0.95 pounds of carbhydrates, while the fat is already in excess. It is plain that neither corn meal nor bran will answer to complete the ration, because if enough of either be added to increase the protein to the required amount the amount of carbhydrates will be raised far too high. What we want is some feeding stuff containing plenty of protein and but little carbhydrates and fat. One such fodder is new process oil meal. We add two pounds of that to the ration, and it then stands thus:

	Organic matter.	Digestible.		
		Protein.	Carbhy-drates.	Fat.
Ration as above	20.10	1.92	11.55	0.57
Two pounds oil meal	1.88	0.54	0.56	0.07
Total	21.98	2.46	12.11	0.64
Standard	24.00	2.50	12.50	0.40

By the addition of the oil meal the ration is made to correspond as closely as is necessary with the standard. While it contains somewhat less carbhydrates than the standard, it contains enough fat to make up the difference. It is quite possible that the actual ration when weighed out would not approach as near to the standard as it does on paper. It must not be forgotten that we are working with averages, both as to composition and digestibility. Any particular fodder is liable to differ more or less from these averages, and therefore all calculations of rations can be approximate only.

Many other combinations of feeding-stuffs might be readily computed which would contain very nearly the amounts of digestible matters called for by the standard. In general any mixture of wholesome feeding-stuffs, which contains the amounts of digestible matter called for by any particular standard, and has a suitable bulk, is a good ration for that particular purpose.

There has been a somewhat general tendency on the part of American experimenters and writers of late years to question the accuracy of these German standards, or at least their applicability to our conditions. One cause of this tendency has doubtless been a too literal interpretation of the feeding standards. It has frequently been assumed, tacitly, if not avowedly, that a feeding standard was the exact expression of a scientific fact, instead of being, as it really is, an average of the results of more or less numerous and exact feeding trials. If, for example, a ration differing more or less from the standard for some purpose, say fattening, has produced as good or better results than one compounded in accordance with the standard, there has been a feeling that the whole system of calculating rations is thereby discredited, whereas it may simply show that further experiment is needed in certain directions.

But making all allowance for this mistaken feeling, it is undoubtedly the fact that some of the feeding standards given above, notably those for maintenance and for fattening, have failed to prove of much service to those who have tried them in this country, while others, notably that for milk, have generally given reasonble satisfaction.

It is worthy of note that the standards for maintenance and for fattening are precisely those which embody the least experience, while that for milk represent the results of a large number of experiments. This fact certainly suggests the possibility that further experiments may result in establishing standards for other purposes as satisfactory as that for milk. In any case, however, these standards are, and are intended to be, simply *aids* to rational feeding, and not infallible formulæ to be blindly followed.

ANALYSES OF FEEDING STUFFS.

By H. P. ARMSBY.

During the period covered by this report one hundred and five samples of fodders have been partially or completly analyzed in the Station laboratory. Of these, ninety-four were examined in connection with the feeding trials elsewhere reported, and do not appear here. The results on the remaining eleven samples are given below. The chemical analyses were executed by Messrs. F. G. Short and F. W. A. Woll, chemists of the Station.

BRAN FROM ROLLER MILLING.

The extensive introduction of the process of roller milling has resulted in bringing upon the feed market large quantities of wheat bran differing so greatly in appearance from the older kind, and so suggestive of chaff or sawdust, that a somewhat prevalent distrust of its value has arisen.

Below are given the results of the chemical analysis of two samples of this bran, taken from two 10-ton lots purchased by the Station for its own use. Number 45 was bought in the autumn of 1884 from the Washburn mills, Minneapolis, and number 143-4 in the autumn of 1885 from the Pillsbury mills of the same place.

For comparison there are also given three analyses made by the U. S. Department of Agriculture, A being of bran from spring wheat, B from Virginia winter wheat, and C from Ohio winter wheat.

Bran — as analyzed.

	No. 45.	No.143-4	A.	B.	C.
Water	14.13	13.68	10.91	8.24	7.74
Ash	6.05	5.29	5.59	6.89	6.99
Protein	15.19	14.69	16.28	16.45	15.40
Crude fiber	10.31	11.77	5.98	6.13	64.88
Nitrogen-free extract	50.96	51.03	56.21	56.77	
Fat	3.36	3.54	5.03	5.52	4.99
	100.00	100.00	100.00	100.00	100.00

The three samples A, B and C were drier than our samples, and consequently appear to have a somewhat higher percentage of some of the other ingredients. If we reduce them all to the water-free state, we shall then be able to make a fair comparison. In the following table this has been done.

Bran — water-free.

	No. 45.	No.143-4	A.	B.	C.
Ash	7.06	6.12	6.27	7.51	7.58
Protein	17.69	17.02	18.27	17.93	16.69
Crude fiber	12.00	13.64	6.71	6.68	70.32
Nitrogen-free extract	59.34	59 13	63.10	61.86	
Fat	3.91	4.09	5.65	6.02	5.41
	100.00	100.00	100.00	100.00	100.00

With the exception of the relatively high percentage of crude fiber in our samples, these analyses show a good degree of uniformity in the composition of bran made by the roller process at different places and from different materials.

To illustrate the difference between this bran and the "old process" bran, we have placed side by side below the average of these five analyses and the average of all analyses of wheat bran published up to 1879. These are nine in number and probably are nearly if not quite all "old process" bran.

Average Composition — water-free.

	Roller bran.	"Old process" bran.
Ash	6.91	5.59
Protein	17.52	14.79
Crude fiber	9 76	9.23
Nitrogen-free extract	60.79	66.12
Fat	5.02	4.27
	100.00	100.00

If we assume these two kinds of bran to contain on the average 12 per cent. of moisture and to have essentially the same digestibility as that found in German experiments, they would contain the following percentages of digestible matter:

Digestible Matter.

	Roller bran.	Old process bran.
	Per cent.	*Per cent.*
Protein	12.03	10.16
Carbhydrates	44.02	47.48
Fat	3.05	2.59
	59.10	60.23

The total amount of digestible matter in the two kinds of bran is not materially different, but in the roller bran there is more digestible protein, slightly more digestible fat, and correspondingly less carbhydrates than in the old process bran.

A microscopical examination of the bran shows at once the reason of this difference, as will appear from the following explanations by Prof. Trelease.

STRUCTURE OF THE WHEAT GRAIN AND OF WHEAT BRAN.

By WM. TRELEASE.

A grain of wheat, as may be seen from figure 1, consists of three evident parts; the germ or embryo plant (*e*), the endosperm, or food destined for the use of the embryo when it begins to develop (*a*), and the brown or reddish membranes that cover both. The parts of interest in connection with flour and bran are the endosperm and its membranes. A section through these (fig. 2), shows that the endosperm, or principal part of the grain, is composed of large cells (5), filled with round or oval starch-grains lying in a finely granular albuminoid substance that becomes the "gluten" of flour. This mass of cells is surrounded by a single layer of

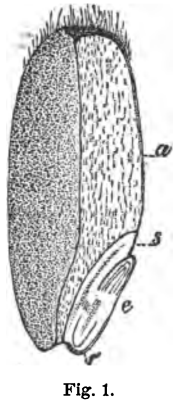

Fig. 1.

Figure 1. Grain of wheat cut longitudinally, (x 7). *a*, endosperm: *e*, embryo; *r*, its roots; *s*, its sheath or "scutellum," by which it absorbs nourishment from the endosperm during germination.

cells of about the same size (4), that contain no starch but are filled with coarse granules of albuminoid matter. These granules are known as aleurone grains, and the layer of cells containing them is the aleurone layer. Covering this layer are several tiers of long thin cells (3), forming the seed coat, which in its turn is closely surrounded by another enveloping membrane (1–2). Though the wheat grain is usually spoken of as a seed, it is in reality a complete fruit; and this outer coat does not properly belong to the seed, but is the wall of the ovary, and hence to be compared with the pod of the bean or pea. As may be seen from the figure, it consists of several layers of long flat cells, the innermost (2) running crosswise of the grain, and for this reason appearing smaller in a longitudinal section; while the others (1) run lengthwise.

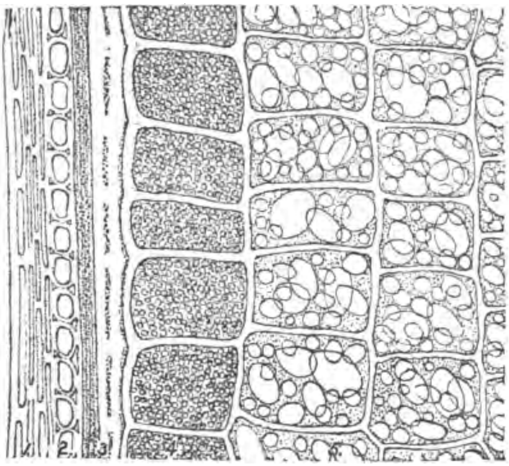

Fig. 2.

Figure 2. Fragment of a longitudinal section of a wheat grain (x 330). 1-2, wall of ovary; 2, "cross-cells;" 3, seed-coat; 4, aleurone cells; 5, starch cells, containing fine gluten grains between the large grains of starch.

In grinding wheat the wall of the ovary and the seed-coat flake away together as "bran;" but this does not happen so as to leave the inner parts entirely in the flour. The old-process bran usually carries with it one or more layers of the starch-cells (5); hence its white, floury appearance. An examination of the roller-process bran shows that the membranes have usually been torn away through the first layer of starch cells so that very little of it presents a white or mealy appearance. In a flake of this bran it is easy to see under the microscope that all of the parts from one to four are present. Figure 3 shows a fragment of this sort, seen from the outside. The long, flat cells (1) are here seen to have an oblong form, their side walls being thickened in places, with intervening thin spots or pits. Where these outer cells are broken away, the cross-cells (2) show, their walls presenting the same pitted appearance. Under the edges of this layer the more delicate cells of the seed-coat are sometimes visible, though they usually tear away further back, as in the specimen figured, so that they do not show.

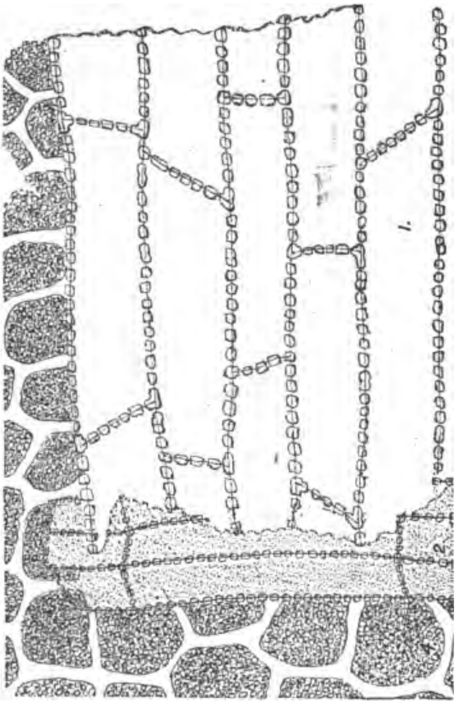

Fig. 3.

Figure 3. Fragment of roller-process bran, seen from the outside, (x 330). 1, surface view of outer cells of the ovary; 2, "cross-cells;" 4, aleurone cells.

Finally, the aleurone-cells (4) are always found as the innermost layer of the bran.

The microscope shows, therefore, that röller-process bran always contains the cells with the highest percentage of nitrogenous matter — those of the aleurone layer. This explains the relatively high percentage of protein found in roller bran. It contains nearly all the protein that the "old process," bran does, with less of the starchy endosoperm to dilute it.

As the analysis shows, the total amount of nutritive (digestible) matters in the two kinds of bran is practically the same; they differ in the proportion of protein to carbhydrates. The relative value of the two will depend somewhat upon the purposes to which they are to be applied. As an addition to a ration already containing an abundance of digestible protein, one would be about as valuable as the other. For supplementing the ordinary coarse fodders, or such feeds as corn-meal which are rather deficient in protein, on the other hand, the greater proportion of protein in the roller bran would render it more valuable, particularly for feeding milch cows or young stock, both of which need a good supply of protein. The starchy matters, while they are necessary for the animal, may be supplied more cheaply than in bran. The ordinary coarse fodders of the farm contain an abundance of them, but are relatively deficient in protein. Obviously, in buying bran, it is economy to select that which contains the most protein, since this is the substance in which our fodders — and the grains as well, especially corn — are relatively poor, rather than to pay ten or eleven dollars per ton for the starch of the old process bran when equally valuable matter may be had in hay or corn fodder for four to eight dollars.

In spite of its unpromising appearance, then, the roller bran proves to be equal or even superior as feed to the "old process" bran, since, while it contains somewhat less of the starchy matters of the wheat, it contains, in 100 pounds, considerably more of the valuable protein. The Station cannot, as yet, report any special feeding tests of the bran, but it has given good satisfaction as a feed. This, we believe, has been the general experience of those who have used it.

Large quantities of wheat bran are being shipped across Wisconsin to supply states to the east of us. This bran contains the elements of fertility drawn from the virgin soils of the northwest, and every car-load fed in our state, in addition to its value as fodder, contributes practically all this fertility to our soil. It is certainly worth considering whether we can afford to let this stream of fertility flow by us unused.

"ROYAL STOCK FOOD."

A sample of about 100 pounds of this article was sent to the Station in January, 1885, by Messrs. E. W. Blatchford & Co., of Chicago, the manufacturers, with the request that its value be tested.

In a letter accompanying the sample the makers say:

> "The want of a thoroughly good feed cake, possessing in addition to the very useful properties of linseed and cotton seed cakes, more of the three ingredients most needed for profitable feeding, viz.: *oil*, *sugar* and *albuminous* compounds, is being felt more and more. The cake we now send you for analysis and practical test has been manufactured expressly to contain the largest possible quantities of these three ingredients, put up in the most convenient form for use. It is composed of the best known flesh, fat and milk producing constituents, * * *"

A chemical analysis showed the sample to have the following composition:

	"Royal Stock Food." No. 47.	Average new process oil meal.	Average old process oil meal.
Water	12.30	10.12	8.34
Ash	6.67	5.93	5.99
Protein	33.94	32.94	30.80
Crude fiber	6.85	9.09	10.00
Nitrogen-free extract	34.53	38.35	34.75
Fat	5.71	3.57	10.12
	100.00	100.00	100.00

The "food" belongs in the same class of feeding-stuffs with the oil-meals and oil-cakes, and approaches most nearly to new process oil-meal in composition. It contains a little more protein and considerably more fat than the latter, and correspondingly less carbhydrates, and for some purposes it would be slightly more valuable, as explained in the remarks upon bran above.

A microscopical examination showed it to contain cotton-seed meal, beans and linseed meal, presumably the old process meal as claimed by the manufacturers. Several other ingredients are also stated by Messrs. Blatchford & Co. to enter into the composition of the food, but as they object to having their formula published, we can only state that they are all materials of recognized feeding value.

There is no doubt that such a mixture, if made of sound materials, would prove a wholesome and nutritious addition to the ordinary feed of cattle and sheep. The manufacturers state that it can be supplied at the same price as linseed cakes. Our analysis shows that it has about the same value as new process oil meal, but, so far as can be judged, it has no very great advantages over either of the feeds named.

It is doubtless true that chemical analysis alone can not finally fix the value of a feeding-stuff, but it does furnish a reasonably trustworthy means of comparing feeding-stuffs of the same class. It is possible that feeding trials may show the "Royal Stock Food" to be superior to other foods of its class, as is claimed by the makers; but from the stand-point of chemical analysis there is no reason to suppose it more valuable than any other oil-cake having the same composition.

SHORTS, CORN, OATS AND BRAN.

The following analyses represent the composition of considerable lots of feeding stuffs purchased by the Station in the autumn of 1885. Two samples of each feed were taken and analysed separately in duplicate in order to obtain some information as to the accuracy with which this class of materials can be sampled.

The corn and oats were grown in the neighborhood of

Madison; the bran was from the Pillsbury Mills, Minneapolis*; the shorts from the Madison Mills. The shorts and bran are the same that were used by Prof. Henry in the feeding experiment, reported on pp. 9–12.

Composition — as sampled.

	SHORTS.		CORN.		OATS.		BRAN.	
	137.	138.	139.	140.	141.	142.	143.	144.
Water	15.52	15.33	22.72	23.40	12.77	12.60	13.37	14.00
Ash	4.00	4.07	1.59	1.46	3.06	2.89	5.14	5.43
Protein	16.06	15.69	8.23	7.86	12.34	12.54	14.63	14.75
Crude fiber	5.84	6.10	2.10	2.29	10.31	10.50	12.75	10.80
Nitrogen-free ext't.	53.26	53.74	61.55	60.72	58.15	56.85	50.51	51.56
Fat	5.32	5.07	3.81	4.27	3.37	4.62	3.60	3.46
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

All these samples, but particularly the corn, contained a much larger proportion of water than that given in the table on page 82. The chief cause of this difference is undoubtedly that the majority of the analyses which enter into the averages were made on samples which had been preserved for some time in dry rooms, and which therefore had become abnormally dry. The proportion of water in commercial corn, especially, is always much higher than that given in the table.

The chief differences between the duplicate samples are also found in the amount of water, while the composition of the water-free substance was substantially identical in nearly every case, as is shown in the following table:

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* The composition of this sample is also given on p. 82.

Composition — water-free.

	SHORTS.		CORN.		OATS.		BRAN.	
	a.	b.	a.	b.	a.	b.	a.	b.
Ash	4.74	4.81	2.06	1.91	3.51	3.31	5.93	6.31
Protein	19.01	18.52	10.63	10.25	14.16	14.35	16.88	17.15
Crude-fiber	6.91	7.20	2.72	2.99	11.83	12.01	14.71	12.56
Nitrogen-free extr't	63.04	63.48	......	......	66.64	65.05	58.32	59.96
Fat	6.30	5.99	......	......	3.86	5.28	4.16	4.02
	100.00	100.00	......	......	100.00	100.00	100.00	100.00

ENSILAGE.

The following sample of corn ensilage was sent to the Station by Hon. Hiram Smith, Sheboygan Falls.

Composition.

Station No. 114.	Fresh Sample.	Calculated Water-free.
Water	81.49	....
Ash	1.25	6.75
Protein	1.02	5.49
Crude fiber	5.74	31.03
Nitrogen-free extract	10.17	54.97
Fat	0.33	1.76
	100.00	100.00

Mr. Smith's sample contains a little more water than the average given on page 82, but otherwise does not differ materially from it in composition.

VALUE OF NEW PROCESS OIL MEAL AS COMPARED WITH CORN-MEAL FOR MILK PRODUCTION.

By H. P. ARMSBY.

In Bulletin No. 4 of this Station, and also in its second annual report, pp. 78 to 95, was given an account of experiments upon the value of two highly nitrogenous feeding stuffs, viz.: cotton-seed meal and malt sprouts, compared with corn meal as food for milch cows. Those experiments failed to show any gain in either quantity or quality of the milk which could be attributed to the use of those substances. In closing the report of the experiments, however, the following words were used:

"In conclusion it should be stated expressly that these results and considerations are presented simply as the teachings of this single feeding trial, and furthermore, that some of the most important conclusions are largely based on results obtained with one animal, while it is uncertain whether those upon the other two confirm them. In short, this experiment is to be regardəd as a preliminary experiment: as pointing out a promising direction for future work rather than itself establishing anything. More extended and accurate experiments are now in progress, designed to test the indications of this one. Until these are completed it will be well to suspend judgment upon the relative merits of oil meal compared with corn meal."

The following pages contain an account of further experiments on the same general subject, executed during the winter of 1885, beginning February 1st and ending May 2d.

The question which both sets of experiments were designed to answer is whether highly nitrogenous foods, such as the various kinds of oil cake, have a higher nutritive value than starchy foods like corn meal and bran. In the earlier experiments cotton-seed meal and malt sprouts were compared with corn meal. In those here reported a feed more familiar to our farmers, viz., new process oil meal, was selected for examination.

PLAN OF EXPERIMENTS.

Throughout the experiments there was weighed out to each cow per day 5 pounds of "roller process" wheat bran, 4 pounds of corn meal, 8¾ pounds of clover ensilage, and 17½ pounds of mixed hay. Considerable of the hay was usually left uneaten, so that the hay feeding was practically *ad libitum.* The small amount of ensilage was given as a relish rather than as furnishing any large amount of nutriment. The above may be called the fundamental ration. To it were added the articles of feed which it was desired to test, as follows:

In period I, 3 pounds of corn meal; in period II, 3 pounds of new process oil meal; in period III, 3 pounds of corn meal and 2½ pounds of oil meal; in period IV, the same as in period I, viz., 3 pounds of corn meal.

The intention was to test in period II the effect of *substituting* oil meal for corn meal, and in period III the effect of *adding* oil meal to corn meal. The varying amounts of hay eaten in the several periods, however, interfered somewhat with this design, the amount of food actually digested by the animals being very little greater in period III than in period II, and in both decidedly less than in periods I and IV with which they were to be com ared. Nevertheless, some interesting results were obtained.

ANIMALS.

Three cows were used for these experiments: Nibbie, Sylvia and Cowry. Nibbie and Cowry are registered Jerseys and are what are known as "standard cows;" that is, they have yielded 14 pounds or more of butter in seven days. Sylvia is about 15-16 Jersey, and though not so good a milker as the other two, would still be considered an excellent cow. Other particulars concerning them are as follows.

Name.	Breed.	Age.	Calved.	Served.
Nibbie	Jersey	7 years......	Nov. 8, 1884	May 5, 1885
Sylvia	Jersey Grade	7 years......	Nov. 17, 1884	Apr. 15, 1885
Cowry	Jersey	9 years.....	Nov. 2, 1884	Mar. 10, 1885

FODDERS.

The following is the average composition of the fodders used:

	Hay.	Ensilage.	Bran.	Corn Meal	Oil Meal.
Water	19.00	77.66	14.61	18.75	13.40
Ash	4.49	1.90	6.64	4.05	3.36
Protein	6.52	3.20	14.88	8.70	30.70
Crude fiber	23.72	5.12	10.24	2.40	8.04
Nitrogen-free extract	44.92	11.10	49.71	61.82	40.55
Fat	1.35	1.02	3.92	4.28	3.95
	100.00	100.00	100.00	100.00	100.00

The hay, ensilage and corn meal were the products of the farm. The hay was mixed hay. The ensilage was from red clover, put into the silo in the summer of 1883 without cutting; it had kept excellently, was but very slightly sour, and was apparently relished by the cows. The corn meal was from Sibley's Pride of the North corn (a dent corn), and was usually ground in a small iron mill by wind power. The bran was from the Washburn mill at Minneapolis, the oil meal from the St. Paul Linseed Oil Co. All the fodders were of excellent quality.

CONDUCT OF EXPERIMENTS.

Each period was three weeks long, with the exception of the first, which was extended to four weeks. The full effect of a change of feed is not realized at once, and hence it is necessary in experiments of this sort to continue the same feeding for some time in order to get trustworthy results.

Each cow's hay was weighed out separately for each half day, in bags, a week's supply at a time, and a sample was at the same time taken for chemical analysis. The grain and ensilage were weighed out from day to day as needed, a small sample being at the same time set aside in a tightly closed jar or cask. At the end of one or two weeks a subsample of the united daily samples was taken for analysis. The cows were fed twice daily, at 5:30 A. M. and at 4:30 P. M. Before the night feed was given, all uneaten hay was removed from the feed boxes and set aside for sampling. At the end of a week a sample of the uneaten hay from each cow was taken for analysis. In all, eighty-six samples of fodders and uneaten residues have been more or less completely analysed during these experiments, involving the making of 342 single determinations. The figures given in the table on page 99 are therefore each the average of a number of determinations.

It is important to know, in addition to how much food is eaten, what amount of it is digested and what proportion passes away from the animal unused in the dung. In the experiments of 1884 this was estimated from the results of digestion experiments with sheep. In those now under consideration the actual amount of food digested by two of the cows (Nibbie and Sylvia) was determined on the last six days of each period. For this purpose a watchman was stationed with the animals day and night, provided with suitable arrangements for collecting all the dung excreted separate from the urine. The excretion of each half day was weighed and a sample at once taken for analysis. In all, sixteen samples of dung were analysed, making a total of 128 single determinations in addition to the fodder analyses already mentioned.

The cows were milked twice daily at 5:30 A. M., and 4:30 P. M. The milk from each cow was at once weighed and a sample of the mixed night's and morning's milk subjected to chemical analysis. The milk from each milking of Nibbie and Sylvia was also set at once for cream in small Cooley cans, and the cream from four successive milkings, after becoming slightly sour, was churned in a small rectangular churn and the well-worked but unsalted butter weighed. Each lot of butter and skim-milk was also subjected to chemiical analysis. In all there were analysed 252 samples of milk, 169 samples of skim-milk, and 69 samples of butter, making a total of 823 single determinations.

The temperature of the stable was noted each day at 7 A. M., 2 and 9 P. M., and the average of these three taken to represent the average daily temperature. When the weather permitted, the cows were usually let out during a part of the day for exercise.

The cows were weighed daily, immediately before watering, and then given all the water (at 40° F.) which they wished, the amount drunk being determined in most cases.

It will be readily seen that daily weighings of animals, food, water, dung, milk, cream and butter for over thirteen weeks, as well as the many chemical analyses mentioned above, involved no small amount of work. The following summary of it may not be without interest.

Weighings.

Of Feed	2,190
Uneaten hay	233
Dung	91
Milk	918
Cream	362
Butter	90
Water drunk	228
Cows	280
	4,401

Temperatures Observed.

Of Milk when set	362
Cooley tank	188
Barn	279
	829

Chemical Analyses.

	Samples.	*Single determinations.*
Fodders and residues	84	342
Dung	16	128
Milk	252	585
Skim milk	169	169
Butter	69	69
	592	1,293

It may be added that each of the 1,293 "single determinations" required the taking of from three to seven weights, very accurately, upon a delicate balance.

The chemical analyses were executed by Mr. F. G. Short, chemist of the Station; the weighings of feed, water and cows were made by Mr. L. H. Adams, Foreman; while the whole care of the milk, cream and butter, including weighing, sampling, creaming and churning was taken by Mr. W. H. Moon, Dairyman. My thanks are due to all these gentlemen for the care and faithfulness with which each carried out his part of the experiment.

The detailed results of all the weighings and analyses just mentioned are not given here as they would only tend to conceal the general result of the experiment behind a mass of detail. The teaching of the experiment can be best gathered from a comparison of the average results for each period, but in order to get these averages, and still more in order to check the trustworthiness of their teaching, it was necessary to have the single results. Our discus: sion will here be confined chiefly to the last week of each period, for which we have very complete data.

TEMPERATURE OF STABLE.

The temperature of the stable has undoubtedly a considerable influence on milk production. The following were the average temperatures of the stable during the last week, the last two weeks and the whole of each period.

	Last Week.	Last two Weeks.	Whole.
Period I	53° F.	40° F.	35° F.
Period II	56° F.	49° F.	46° F.
Period III	54° F.	50° F.	46° F.
Period IV	58° F.	59° F.	55° F.

For the last week of each period, the temperature was practically the same. For the last two weeks and for the whole periods, the temperature in periods II and III is almost exactly the average of that of periods I and IV.

WATER DRUNK.

The following are the average daily amounts of water drunk in each week of the experiment:

	Nibbie.	Sylvia.	Cowry.
PERIOD I.	*Pounds.*	*Pounds.*	*Pounds.*
1st week	67.3	58.7	72.4
2d week	68.2	60.3	70.4
3d week	64.5	57.1	77.4
4th week	75.7	58.7	69.7
PERIOD II.			
1st week	82.7	59.4	71.7
2d week	66.4	59.2	63.6
3d week	74.4	68.0	78.8
PERIOD III.			
1st week	62.3	51.7	60.3
2d week	45.8	51.7	....
3d week	59.3	52.4	54.4
PERIOD IV.			
1st week	50.2	43.3	48.8
3d week	61.6	57.9	70.6

I have not been able to trace any connection between the amount of water drunk and the yield of milk.

LIVE WEIGHT.

In spite of liberal feeding, the weight of all the cows fell off very markedly in the course of the experiment, Nibbie losing about 90 pounds, Sylvia about 40, and Cowry about 80. The cause of this loss appeared to be the confinement and lack of variety in the food which are unavoidable in experiments. As is always the case, the weights varied greatly from day to day. On comparing the daily weighings with the amount of water drunk, a very striking coincidence was noticed, the live weight as arule (not always) rising and falling as the amount of water drunk was greater or less. From evidence which it would occupy too much space to give at length, I believe I am justified in assuming as *probable* that the actual weight of the tissues of the animals decreased at a nearly uniform rate during the whole experiment, and that the apparent variations from this rate were due to variations in the contents of stomach and intestines, particularly in the amount of water which they contained.

If this assumption is correct, the amount of their own flesh and fat which the animals put into milk was very nearly the same in each week or period, and may be left out of account in considering the effects of the feeding. The subsequent discussion of the results is based upon this assumption, and it must not be forgotten that the conclusions reached have no greater degree of probability than this assumption has.

RATIONS FED.

As already stated, the exact amount of food digested in the last week of each period by two of the cows was determined. The following table gives in a condensed form all necessary information concerning the ration for each period. The second column shows the total amount of dry matter eaten per day, the water of the fodders being neglected as unessential. The third column shows how much dry matter was digested per day. The fourth column shows how much organic matter this digestible dry matter contained; that is, it is the dry matter minus ash. The next three columns serve to divide up the organic matter into its components, protein, carbhydrates (starchy matter) and fat. The last column shows the ratio of digestible protein to digestible carbhydrates and fat.

Rations Per Day.

	Dry matter eaten.	Digested.					Nutritive ratio.
		Dry Matter.	Organic Matter.	Protein.	Carbhydrates.	Fat.	
	lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	
Nibbie —							
Period I .	21.88	13.69	13.44	1.13	11.78	0.53	1:11.4
Period II .	18.35	11.71	11.65	1.81	9.44	0.40	1:5.8
Period III .	18.66	12.21	12.00	1.55	9.90	0.55	1:7.2
Period IV .	19.87	12.46	12.16	1.43	10.19	0.54	1:8.0
Sylvia —							
Period I .	21.78	13.67	13.26	1.09	11.67	0.50	1:11.7
Period II .	20.60	12.17	12.20*	1.84	9.99	0.37	1:5.9
Period III .	20.13	12.46	12.25	1.40	10.33	0.52	1:8.2
Period IV .	21.02	12.44	12.09	1.32	10.31	0.46	1:8.6
Cowry —							
Period I .	22.51	Not determined.	Not determined.	Not determined.	Not determined.	Not determined.	
Period II .	19.08						
Period III .	20.00						
Period IV .	21.64						

* That the organic matter exceeds the total dry matter may be either due to some error or to an excessive excretion of mineral matter by the animal.

QUALITY OF THE MILK.

The quality of the milk produced may be judged of either from the results of chemical analysis or of churning tests. The following table shows the average chemical composition of the milk produced during the last week of each period:

Per cent. of Fresh Milk.

	Water.	Solid Matter.	THE SOLID MATTER CONTAINED.	
			Fat.	Protein.
Nibbie—	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Period I	84.08	15.92	6.15	3.44
Period II	83.35	16.65	6.35	3.50
Period III	84.48	15.52	5.96	3.31
Period IV	85.00	15.00	5.56	3.38
Sylvia—				
Period I*	84.19	15.81	5.59	3.56
Period II	84.04	15.96	5.72	3.78
Period III	84.02	15.98	5.98	3.94
Period IV	83.90	16.10	6.07	3.56
Cowry—				
Period I	83.03	16.97	6.56	3.69
Period II	83.96	16.04	6.19	3.81
Period III	83.40	16.60	6.50	3.69
Period IV	84.03	15.97	6.14	3.69

*Third week of period.

Taking the percentage of solid matter as the fairest measure of quality, we find that in periods II and III, in which oil meal was fed, the quality of Nibbie's milk was above the average of periods I and IV, and that of Sylvia's fully up to the average, and this notwithstanding that, as shown on p. 105, the quantity of food eaten and digested in these periods was below the average. In other words, in the periods in which oil meal was fed, and presumably on that account, the quality of the milk was maintained in Sylvia's case and improved in Nibbie's in spite of a deficiency in the quantity of the food. The same is true of Cowry's milk in period III, but period II shows a very decided drop. As, however, we have less complete knowlege of the composition of Cowry's food, we may say that the balance of evidence is strongly in favor of the conclusion that the oil meal improved the quality of the milk by making it less watery. This conclusion is in harmony with the results of numerous other similar experiments.

Plainly, however, this alone does not settle the value of oil meal, for we must take account of quantity of milk as well as quality.

The principal variations in the composition of the milk are variations in the proportion of water, the relation of the several solid ingredients of the milk to each other being in most cases practically unaffected. This will appear if we compute what the composition of the milk would have been had it contained uniformly 85 per cent. of water. The feed having been substantially the same in periods I and IV, we may safely assume that the differences in the percentages of fat and protein in these two periods represent changes in the composition of the milk due to advancing lactation, and that these changes would have gone on at a nearly uniform rate had there been no change in the feeding. In the following table there is given under the heading of "calculated," the percentage of fat or protein respectively which the milk would have contained in each period upon this assumption, while the column headed " observed " show the percentages actually found in the milk under the changed conditions of feed. The close agreement of the two sets of figures shows that the changes in the feeding had no appreciable influence upon the composition of the milk, except, as above noted, to make it less watery.

Milk with Eighty-five Per Cent. Water.

	Fat.		Protein.	
	Calculated.	Observed.	Calculated.	Observed.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Nibbie —				
Period I	5.79	5.79	3.24	3.24
Period II	5.71	5.72	3.29	3.15
Period III	5.63	5.76	3.34	3.20
Period IV	5.56	5.56	3.38	3.38
Sylvia —				
Period I	5.30	5.30	3.38	3.38
Period II	5.42	5.38	3.36	3.55
Period III	5.54	5.66	3.34	3.70
Period IV	5.66	5.66	3.32	3.32
Cowry —				
Period I	5.80	5.80	3.26	3.26
Period II	5.79	5.79	3.33	3.56
Period III	5.78	5.86	3.40	3.33
Period IV	5.77	5.77	3.46	3.46

A possible exception to the above statement is found in the protein of Sylvia's milk in periods II and III, and of Cowry's in period II, in both of which cases a small increase of the protein seems to have occurred. It should be noted, however that the figures for protein are the results of fewer analyses than those for fat.

If we take as our measure of the value of the milk the amount of it required to produce a pound of butter, we get the following results for Nibbie and Sylvia. Cowry's milk was not churned.

Milk Required to make One Pound of Butter.

LAST WEEK OF	Nibbie.	Sylvia.
	Pounds.	*Pounds.*
Period I	14.62	*15.07
Period II	14.03	15.32
Period III	14.32	14.72
Period IV	16.08	14.72

*Third week.

The results on Nibbie's milk corresponded with the indications of chemical analysis, the quality being better in periods II and III than in periods I and IV. The same is true of Sylvia's milk in period III, but not in period II, the quality in this period being poorer than in any other.

Chemical analyses were also made of the butter, but the method of sampling adopted proved to be untrustworthy, and the results of some seventy analyses were thereby rendered worthless.

QUANTITY OF MILK PRODUCED.

The following are the average quantities of milk produced per day by each animal during the last week of each period:

	Nibbie.	Sylvia.	Cowry.
	Pounds.	*Pounds.*	*Pounds.*
Period I	19.14	16.13*	17.78
Period II	17.58	15.58	17.91
Period III	18.19	14.54	16.76
Period IV	17.60	14.37	16.94

* Third week.

As has already been pointed out, however (see table on page 106), the proportion of water in the milk varied from period to period. Plainly we cannot make a fair comparison of one period with another under these circumstances. We must first get rid of the influence of this varying proportion of water. A fair comparison may be made by computing what the yield of milk would have been had the same amount of solid matter been contained in milk which had a uniform water-content, say of 85 per cent. In this way we may take account of the effect of the feed upon both quantity and quality of the milk. The following table contains the results of this calculation:

Milk with 85 *per cent. water. Daily yield.*

LAST WEEK OF.	Nibbie.	Sylvia.	Cowry.
	Pounds.	*Pounds.*	*Pounds.*
Period I	20.32	17.00*	20.12
Period II	19.51	16.58	19.15
Period III	18.82	15.53	18.55
Period IV	17.60	15.42	16.04

* Third week.

This table may be supplemented by two others, the first showing the number of pounds of fat contained in the average daily yield of milk, and the second showing the average daily product of butter. We shall then have brought together our data from which to judge of the effects of the feeding.

Average Daily Yield of Fat.

	Nibbie.	Sylvia.	Cowry.
Period I	1.18 lbs.	0.90 lbs.	1.17 lbs.
Period II	1.12 lbs.	0.89 lbs.	1.11 lbs.
Period III	1.08 lbs.	0.87 lbs.	1.09 lbs.
Period IV	0.98 lbs.	0.87 lbs.	1.04 lbs.

Average Daily Yield of Unsalted Butter.

	Nibbie.	Sylvia.
Period I	1.31 lbs.	1.01 lbs.
Period II	1.25 lbs.	1.02 lbs.
Period III	1.27 lbs.	0.99 lbs.
Period IV	1.09 lbs.	0.88 lbs.

That the yield of butter is greater than the total amount of fat contained in the milk is due to the fact that butter contains some 14 or 15 per cent. of water and a trifling amount of other substances in addition to its fat.

WHAT DO THE RESULTS SHOW?

We now come to the main question, viz.: what relation can be traced between the production, as shown in the last three tables, and the feeding.

There are numerous ways in which the solution of this question may be attempted. Most of them have been applied to the consideration of the above results in all their details, and they all lead to essentially the same conclusion. I therefore present here only one or two of them as illustrative of the conclusions which I reach in whatever light the results are viewed.

A simple method of comparison is to calculate the number of pounds of feed required to produce a pound of milk. To make this a fair comparison we plainly must take the feed in a perfectly dry state and the milk with a uniform water content, say 85 per cent. Or, instead of making the dry matter of the food our basis, we may compute how many pounds of digested dry matter were required to produce a pound of milk. Or, we may take as the basis of calculation what is called the starch-equivalent of the digested matter, which is found by multiplying protein by 1.1 and fat by 2.2, and adding the result to the carbhydrates. The following table contains the results of a comparison on each of these bases:

To Make One Pound of Milk Required.

	Total dry matter.	Digestible dry matter.	Starch equivalent of digestible dry matter.
NIBBIE.	*Lbs.*	*Lbs.*	*Lbs.*
Period I	1.08	0.67	0.70
II	0.94	0.60	0.63
III	0.99	0.65	0.68
IV	1.13	0.71	0.74
SYLVIA.			
Period I	1.28	0.80	0.82
II	1.24	0.73	0.77
III	1.30	0.80	0.84
IV	1.36	0.81	0.83
COWRY.			
Period I	1.12		
II	1.00		
III	1.08		
IV	1.20		

In general, though with a few exceptions, periods II and III, in which oil-meal was fed, show a slightly more economical production than periods I and IV; that is, it took a little less feed to make a pound of milk. The same result is reached by comparing the production of milk fat or of fresh butter with the food eaten.

It would appear, then, that there was in these experiments some advantage in substituting oil meal for corn meal, though it is evidently not great. It is possible, however, that even this small advantage is only apparent.

It will be remembered (see p. 104) that we assumed that the actual weight of the animals, exclusive of contents of stomach and intestines, fell off at a uniform rate throughout the experiments. It is by no means certain however, that this was exactly the case. If, now, the weight really fell off a little faster in periods II and III, this might account for the better results in those periods. A careful study of the daily weighings shows that a difference fully sufficient to account for the better results in those periods in which oil meal was fed would accord with the observed facts at least as well as the assumption of uniform loss of weight with which we started.

This robs the apparent gain in periods II and III of all significance. It does not, of course, prove that the gain was not due to the oil meal, but, on the other hand, it renders it impossible to prove that it was. That is, the experiments agree with those of the previous year in so far as they fail to show with *certainty* any gain resulting from the use of oil meal, while they do show that if there was really a gain it was small.

COST OF THE FEEDING.

Oil meal costs considerably more than any other of the feeding-stuffs used in these experiments. If, now, there was really a gain due to the use of the oil meal, was it sufficient to compensate for the extra cost of the feeding? Assuming hay to be worth $8 per ton, ensilage $2, bran $12, corn meal $20, and oil meal $25, and charging nothing for the uneaten hay, the cost of feed per 100 pounds of milk with 85 per cent. of water in the several periods was as follows:

Cost of Feed per 100 *Pounds of Milk.*

	Nibbie.	Sylvia.	Cowry.
	Cents.	*Cents.*	*Cents.*
Period I	74.8	98.3	79.6
Period II	76.1	96.3	79.4
Period III	74.6	95.1	79.3
Period IV	84.4	100	88.3

The cost of the milk in periods II and III is without exception less than the average cost in periods I and IV, when we take as the basis of our calculation milk with a uniform percentage of water; that is, when we take account of the improved quality of the milk in periods II and III. From this it would appear that, if the better effect in periods II and III was really the result of the feeding and not of a greater loss of weight by the animals, it was profitable to substitute oil meal at $25 per ton for corn meal at $20. If the greater value of the manure from oil meal were taken into the account, the balance would be still more in favor of the latter.

In studying the above figures regarding the cost of the milk, the object of the experiment should be remembered. This was not to see how cheaply or how profitably milk could be produced. It was a matter of entire indifference whether the feed to produce a given amount of milk cost one dollar or two or three. In a feeding trial of this sort the conditions are very unfavorable to *economical* production, owing to the enforced uniformity of feed, restricted exercise, etc., etc. The only value of a calculation of the cost of the milk is to show whether it was increased or decreased by the use of oil-meal; that is, to show the *relative* cost in the several periods.

CONCLUSIONS.

The results of these experiments may be briefly summarized as follows:

1. The considerable loss of weight by the animals prevents any certain conclusions being drawn.

2. Neither these experiments nor those of the previous year have shown with certainty that oil meal has any greater feeding value than corn meal.

3. If there is any balance in favor of oil meal it is not great. The probability is, in my opinion, that the "starch equivalent" of feeding stuffs pretty nearly represents their relative value as food.

4. If the apparent gain under oil meal feeding be accepted as real, the cost of feed was about 4 cents less per 100 lbs. of milk when oil meal was fed.

5. The oil meal in these experiments appears to have improved the quality of the milk by making it less watery. There is no evidence that it materially altered the proportion of fat to other solid matters.

FARMERS' EXPERIMENTS ON THE VALUE OF OIL MEAL COMPARED WITH CORN MEAL.

Reported by H. P. ARMSBY.

In order to obtain further light upon the relative value of oil meal and corn meal for milk production, the attempt was made to have a number of farmers in the state carry out a simple feeding trial upon this subject, and the following circular was sent to sixteen farmers in different parts of the state.

AGRICULTURAL EXPERIMENT STATION.
MADISON, WISCONSIN, November 3, 1885.

Dear Sir — You are perhaps aware that this Station has been carrying on, for the past two years, experiments on the comparative value of corn meal and the oil meals as feed for milch cows. We are now desirous of testing our conclusions by a number of experiments under the varying conditions of practice. Are you willing to aid us by conducting a simple feeding trial this winter according to the enclosed plan, and reporting the results to us for publication? The experiment has been planned to involve as little additional labor as possible, and we hope you will feel inclined to undertake it.

Very truly yours,

H. P. ARMSBY.
Professor of Agricultural Chemistry

Out of the sixteen to whom this circular, accompanied by the directions for the experiment which are printed below, was sent, six replied, and two of the six undertook to make the experiment. Of these two, a report has been received from one, Mr. Aug. H. Paulsen, of New Holstein, to whom the thanks of the Station are due for the care with which he has executed the experiment.

The following are the instructions as sent out:

PLAN OF FEEDING EXPERIMENT ON COMPARATIVE VALUE OF CORN MEAL AND OIL MEAL.

The experiment is divided into three periods, which should be not less than three weeks each. Throughout the experiment the cows used, treatment of cows (as to time of feeding, watering, milking, etc.), coarse fodder used (hay, straw, corn-stalks, etc.) should be the same.

The grain feed differs in the different periods.

In the *first period* give such a grain feed as, in your judgment, will give you the most satisfactory returns, including in it a fair amount of corn meal but NO oil meal, pea meal, or other nitrogeneous feed. Give the *same amount every day*.

In the *second period* give the same amount of grain, but in place of four pounds of corn meal give 4 pounds of new process oil meal. For example, if you fed 7 pounds bran, and 5 pounds corn meal per head in the first period, give 7 pounds bran, 1 pound corn meal, and 4 pounds oil meal in the second period.

In the *third period*, give exactly the same feed in every respect as in the first period.

It is desirable to use as many cows as possible, but none should be included that will go dry before the end of the experiment.

The most convenient way of mixing the grain will probably be to weigh out a considerable amount in advance, in the proper proportions, and shovel well together on a tight floor. Thus, if the ration is to be 7 pounds of bran to 5 pounds of corn meal, one might mix 700 pounds of bran with 500 pounds of corn meal. Having mixed the feed, weigh out the quantity necessary for one feed for the whole herd, measure it (struck measure), and feed this measured amount each day. Be sure to give the same *weight* of mixed grain per day in each period.

In reporting results, give amounts of grain fed and of milk and butter (if you make butter) produced. It would be desirable to have a record for each day. If that is not possible, give the amount for each week, or, at worst, for each period, separately.

It is not necessary nor desirable to weigh the feed or milk for each cow separately. Treat the whole herd as if it were one big cow. Give a fixed

amount of feed per day to the whole herd, distributing it among the cows according to your judgment. So also with the yield of milk and butter; report the total product of all the cows derun experiment.

The results reported by Mr. Paulsen were the following:

Period I.

Feed per day and head: 15 pounds of hay (mixed clover and timothy), 10 pounds sorghum, 5 pounds corn-meal, 4 pounds oat-meal, and some straw. The milk yield of 4 cows was:

	Pounds.		*Pounds.*
January 1	80	January 13	77½
2	81	14	77½
3	80	15	77½
4	80½	16*	80
5	78½	17	77½
6	76½	18	75
7	74	19	77½
8	72½	20	77
9	75½	21	77¼
10	76½		
11	75½	Average of last two weeks	76.86
12	79		

Period II.

Feed per day and head same as in period I, except that three pounds of the corn meal were replaced by three pounds of oil meal. The milk yield of four cows was:

	Pounds.		*Pounds*
January 22	80	February 3	86½
23	82½	4	89
24	82	5	86½
25	84	6	90½
26	85½	7	86½
27	86	8*	92
28	86	9	88
29	83	10	89
30	89½	11	89
31	88½		
February 1	88½	Average for last two weeks	88.20
2	88½		

*An unusually warm day.

Period III.

Feed per day and head same as in period I. The yield of four cows was:

		Pounds.
February	12	88½
	13	88
	14	86
	15	81½
	16	81
	17	76½
	18	73
	19	70½
	20	70
	21	69
	22	68½
	23	68
February	24	67½
	25	67½
	26	67½
	27	66
	28	66½
March	1	67
	2	68
	3	68
	4	70
Average for last two weeks		68.14

It ought to be noted that the cows used were young (two years old), and were not fresh in milk, having calved in the fall. Consequently the milk yield, although satisfactory, was by no means extraordinary.

During the first period the cows lost in weight an average of 7½ pounds. During the second period they gained 9¾ pounds, and in the third period lost again 10 pounds. Both the production of milk and the gain in weight point in favor of oil meal.

These results apparently contradict those of the preceding experiment, which failed to show any material benefit from the use of oil meal. It is to be noted, however, that Mr. Paulsen's rations in the first and third periods probably contained a less proportion of protein than did the ration used in the Station's experiments. Consequently we should expect that an equal increase in the protein, coming, in each case, from the substitution of three pounds of oil meal for three pounds of corn meal, would show a greater effect in Mr. Paulsen's experiment.

Some further experiments at the Station, soon to be published, seem to indicate that the result of substituting more nitrogenous feeds in a ration depends largely upon the character of the ration: that, if it contains already a good supply of protein, the effect will be small, while in the opposite case it may be quite marked.

THE COOLEY SYSTEM OF CREAMING MILK.

By H. P. Armsby.

That form of the deep setting of milk known as the Cooley system has, in one form or another, come into very general use in this country, a fact which attests the general satisfaction which it has given. At the same time, few, if any, exact determinations of the efficiency of the process in separating the fat from milk have been made, so far as I am aware. The yield of butter has naturally been the criterion by which the process has been judged, and undoubtedly this is the proper standard by which to measure its commercial value.

It is none the less true, however, that the amount of butter obtained depends upon various circumstances besides the efficiency of the process employed to raise the cream, and it is not unimportant to be able to judge of this part of the process by itself. In this way, by learning, first, how much butter is contained in the milk itself; second, how much of this is separated in the cream or remains in the skim-milk; and third, how much is lost in the buttermilk, we are able to see the exact point where there is the best chance of making an improvement. It is the second of these points which forms the subject of the experiments about to be described, viz.: the separation of the cream from the milk.

In making such an examination as this of a method of creaming milk, we need, first of all, a standard by which to measure the results obtained. Neither the bulk nor weight of the cream thrown up will answer, not only because they are very variable under different conditions of setting, but because they depend upon the quality of the milk used, while we wish to be independent of this influence in our comparisons. Neither will the amount of butter which can be made from the cream serve as a standard, for the butter contains a variable amount of water and buttermilk, even after the most careful washing and working. The best, and in fact the only standard by which to estimate accurately the creaming of milk is the amount of pure fat contained in the milk and in the cream which it throws up. The comparison is made as follows: Suppose that we have set 20 pounds of a milk which chemical analysis shows to contain 4 per cent. of fat. The 20 pounds of milk, then, contain 0.8 pounds of pure fat. After the usual time we draw off the skim-milk and weigh and analyze it. We find we have, let us say, 14 pounds of skim-milk containing 0.3 per cent. of fat. The 14 pounds of skim-milk, then, contain 0.042 pounds of pure fat, and the cream must contain the remainder of the 0.8 pounds present in the milk, *i. e.*, 0.758 pounds. We have, then, divided the fat of the milk into two portions, viz.: 0.042 pounds in skim-milk and 0.758 pounds in the cream.

But 0.758 pounds is 94.75 per cent. of the original 0.8 pounds and, therefore, we may say more briefly, that we have recovered 94.75 per cent. of the fat of the milk in the cream. This number, which expresses the percentage of the total fat of the milk which is recovered in the cream is called the *percentage creaming*, and is our measure of the efficiency of the creaming process. Evidently, the greater the percentage creaming, the better, other things being equal, does the creaming process work.

In connection with the feeding experiments recorded in this and the previous report, I have had occasion to make between two and three hundred settings of the milk of single cows by the Cooley system, the milk and skim-milk being weighed and analyzed, as in the example above, thus furnishing data for judging of the efficiency of the system. As will appear from a reference to the account of the experiments, milk from three cows was set, viz.: "Nibbie," a registered Jersey, and "Jersey" and "Sylvia," Jersey grades. All were comparatively new in milk. As regards the feeding, four periods of two to four weeks each were observed with each animal. It does not appear necessary to repeat here a statement of the several rations, as there are no indications that they affected the creaming. All were on dry feed with the exception of nine pounds per day of clover ensilage to Nibbie and Sylvia. The milk stood eleven hours before skimming.

It would occupy too much space and serve no useful purpose to give here in detail the result of each one of these experiments. It will be sufficient to present the average creaming in each of the four periods with each animal, together with a few other important points, as in the following table:

Percentage Creaming of Milk. Average.

PERIOD.	Amount of milk set.	Fat of skim-milk.	Creaming.	Temperature of milk when set.	Temperature of water in tank.
	Lbs.	Per cent.	Per cent.	°F.	°F.
			JERSEY. 1884.		
I	17.85	0.69	92.02	88.5	33.3
II	18.79	0.46	94.03	90.3	34.5
III	17.87	0.52	93.79	90.1	34.3
IV	17.46	0.42	94.58	91.6	34 5
			NIBBIE. 1885.		
I	18.33	0.24	97.49	89.6	34.5
II	19.51	0.19	97.88	91.9	36.7
III	19.38	0.19	97.91	93.0	36.9
IV	16.53	0.25	97.50	94.6	36.9
			SYLVIA. 1885.		
I	15.27	0.31	96.91	88.3	34.3
II	14.56	0.43	95.32	91.2	36.9
III	14.39	0.26	96.98	92.8	36.9
IV	13.30	0.27	97.24	93.9	36.9

In considering these results, it should be remembered that the milk was Jersey milk, which, according to general experience, creams more completely than that of most other breeds. Moreover, the water in the tank was kept rather colder than would usually be the case. For both these reasons the percentage creaming obtained in these experiments was probably somewhat higher than would be attained in general practice with mixed milk. Taking the results as they stand, they are exceedingly satisfactory. From 92 to almost 98 per cent. of the fat of the milk was recovered in the cream in eleven hours, and the percentage of fat in the skim-milk was reduced to between 0.7 and 0.2 per cent., or as low as is possible by any process except the use of the centrifugal. As already intimated, these experiments were undertaken with other objects in view than investigating the creaming of milk. Hence, no comparisons have been made of the Cooley with other systems, or of the efficiency of the Cooley system under differing conditions.

In regard to the first point, it may be said that all forms of deep setting would probably give about the same results with the same milk under like conditions. In some recent trials, Schrodt, a German experimenter, obtained somewhat better results (2–8 per cent.) by the Cooley process than by the so-called Schwartz system, in which the milk is set in cans open at the top and surrounded by cold water up to a point an inch or two below the level of the milk. His trials were hardly numerous enough, however, to show that this and similar methods of setting are really inferior to those in which the can of milk is entirely immersed in the cold water.

The most important condition affecting the results of deep setting appears to be the difference of temperature between the milk and the water of the tank. Any thing which diminishes this difference, whether by allowing the milk to cool off after milking, or by permitting the temperature of the water to become too high, seems to affect the creaming unfavorably. This is well shown in the experiments of Prof. Henry, published in the last report of this Station, where losses of from 3 to 30 per cent. of the butter were observed in consequence of allowing the water in the tank to become warmed up 5° or 10° Fahrenheit, or of allowing the milk to cool before setting it.

How favorable a result may, on the other hand, be obtained when due attention is paid to keeping the temperature of the water as low as possible and to prompt setting of the milk was strikingly illustrated in the official tests of the Jersey cows, Hilda D. and Evelina of Verna, in the summer of 1885. According to the analyses of Dr. S. M. Babcock of the New York Agricultural Experiment Station, in the one case 96.79 per cent. and in the other case 99 per cent. of the fat of the milk was recovered in the butter, so that, after allowing for the loss of fat in the buttermilk, the creaming must have been very perfect. In fact the skim-milk contained less than 0.1 per cent. of fat in nearly every case.

In the experiments reported here the variations of temperature were too small to have any appreciable effect upon the creaming.

Finally, it is worth noting that there were decided individual differences between the three cows used. The most complete creaming was obtained with Nibbie, and the poorest with Jersey, while Sylvia stands between the two in this respect. Such differences are probably connected with differences in the size of the fat globules of the milk, and in the breeding of butter cows this is a point well worth attention.

RELATION OF THE FAT OF MILK TO THE BUTTER YIELD.

By H. P. ARMSBY.

In the experiments just reported, the cream obtained from each day's or two days' setting was churned separately and the weight of the well-worked fresh butter recorded. These records furnish data for comparing the percentage of fat found in the milk by chemical analysis with the amount of butter which can be obtained from it by the ordinary methods. As before, the results reported are averages for longer or shorter periods. The fourth column of the table shows the percentage of fat found by chemical analysis; the fifth, shows the percentage of butter obtained by churning (*i. e.* butter per 100 lbs. of milk); the last, shows the ratio between the two percentages. The fact that the butter obtained usually weighed more than the total fat of the milk is explained by the fact that fresh butter contains some 15 per cent. or more of water and small amounts of other ingredients, besides its fat.

NAME OF COW.	Period.	Date.	Fat. per cent.	Butter. per cent.	100 of fat correspond to butter.
Jersey	I	Feb. 27–Mar. 18, '84.	4.52	4.42	97.8
	II	Mar. 18–Apr. 8, '84.	4.16	3.85	92.6
	III	Apr. 8–22, '84......	4.03	3.91	97.0
	IV	Apr. 22–May 13, '84	3.84	4.20	109.3
					Av. 99.2
Nibbie	I	Feb. 1–7, 1885.....	5.97	7.16	120.0
		Feb. 8–14, 1885....	6.07	7.27	119.7
		Feb. 15–21, 1885....	6.08	7.00	115.2
		Feb. 22–28, 1885....	6.15	6.83	111.1
	II	March 1–7, 1885...	5.65	6.68	118.1
		March 8–14, 1885..	5.96	7.00	117.4
		March 15–21, 1885..	6.35	7.13	112.3
	III	March 22–28, 1885..	5.54	6.35	114.6
		Mar. 29–Apr. 4, 1885	5.82	6.74	115.7
		April 4–11, 1885....	5.96	6.98	117.1
	IV	April 12–18, 1885...	6.28	7.29	116.1
		April 19–25, 1885...	5.45	6.19	113.6
		Apr. 26–May 2, 1885	5.56	6.22	111.8
					Av. 115.6
Sylvia	I	Feb. 1–7, 1885.....	6.14	6.64	108.1
		Feb. 8–14, 1885....	5.72	6.59	115.1
		Feb. 15–21, 1885....	5.59	6.64	118.7
		Feb. 22–28, 1885....	7.79	8.87	113.5
	II	March 1–7, 1885...	6.26	6.77	108.1
		March 8–14, 1885..	5.99	6.72	112.0
		March 15–21, 1885..	5.72	6.53	114.0
	III	March 22–28, 1885..	5.86	6.55	111.6
		Mar. 29–Apr. 4, 1885	5.98	6.94	116.0
		April 4–11, 1885...	5.98	6.79	113.7
	IV	April 12–18, 1885...	6.40	6.98	109.1
		April 19–25, 1885...	5.84	6.94	118.8
		Apr. 26–May 2, 1885	6.06	6.79	112.0
					Av. 113.1

While there are some variations, the yield of butter from each individual cow runs pretty closely parallel to the percentage of fat in the milk, the two increasing or decreasing together in nearly every case. It should be noted, however, that there were no very radical changes in the feeding in these experiments. Other observers have sometimes noticed quite considerable changes in the relation between total fat and butter as the result of changes in the feeding. Thus Sturtevant* found in one of his experiments that the butter product of his cows was only 74.73 per cent. of the total fat of the milk when the ration consisted of hay and gluten meal, while on a ration of hay, corn meal and bran the proportion was as high as 98.40 per cent., and other rations showed intermediate results. Alvord, in experiments at Houghton Farm, found that the use of succulent food, such as roots or ensilage, in winter feeding caused a marked increase in the proportion of fat recovered in the butter.

Finally, there are undoubtedly breed and individual differences between cows in this respect, as is indicated in the above experiments, so that chemical analysis alone is not a sufficient guide in comparing different cows with each other with regard to the value of their milk for butter.

ANALYSES OF FERTILIZERS.

By H. P. ARMSBY.

The following paragraphs are reprinted from the previous reports of the Station, both that they may be conveniently referred to in connection with the analyses reported below, and for the information of those into whose hands the former reports have not come.

Hitherto Wisconsin farmers have very seldom felt the necessity of supplementing their home supply of fertilizing material by the purchase of artificial fertilizers. This is largely the case to-day, but as the fertility of the farming land of the state becomes gradually exhausted by the export of the products of the soil and by wasteful systems of farming, the demand for outside aid to restore that fertility will become more and more general. Already the consumption of commercial fertilizers in this state is increasing and it will doubtless continue to increase.

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* Second report N. Y. Agricultural Experiment Station, 113–116.

This is not the place for a discussion of the value of such fertilizers in agriculture, or of the best methods of using them, but as the Station has already been called upon in a few cases to examine and pronounce upon the quality of these materials, a brief statement of the uses of the chemical analysis of fertilizers, and of the precautions necessary in order that the results may not be misleading, will not be out of place.

Hardly any articles of trade are more easily adulterated than commercial fertilizers, and in hardly any is it more difficult to detect falsification by simple inspection. Even the grossest frauds in these articles may entirely escape the notice of the purchaser. By the help of chemical analysis, however, it is possible to determine the amount of valuable matter in the fertilizer, and to tell with a reasonable degree of accuracy whether it is worth the price asked for it.

As stated on p. 3, the Station is prepared to make such analyses gratuitously for citizens of Wisconsin on certain conditions. But as the making of such analyses involves no little labor and expense (the usual charge for fertilizer analysis varying from $10 to $50 or more according to the nature of the fertilizer), the Station feels justified in insisting rigidly upon compliance with those conditions. The propriety of the second and third conditions, viz.: that the results must be likely to be of use to the public, and that the Station shall have full liberty to use the results as it sees fit, is very evident when it is considered that the Station is in effect supported out of the public funds. A few words may, perhaps, be added here with regard to the first condition, viz.: that samples must be taken in accordance with the Station's instructions.

These instructions are as follows:

INSTRUCTIONS FOR SAMPLING COMMERCIAL FERTILIZERS.

The *commercial value* of a high priced fertilizer can be estimated, if the percentages of its principal fertilizing elements are known. Chemical analysis of a small sample, so taken as to fairly represent a large lot, will show the composition of the lot. The subjoined instructions, if faithfully followed, will insure a fair sample. Especial care should be observed that the sample neither gains nor loses *moisture* during the sampling or sending, as may easily happen in extremes of weather, or from even short exposure to sun and wind, or from keeping in a poorly closed vessel.

1. Provide a tea cup, some large papers, and for each sample a glass fruit jar, holding about one quart, that can be tightly closed, all to be clean and dry.

2. Weigh separately at least three (3] average packages (barrels or bags) of the fertilizer, and enter these *actual weights* in the "Form for Description of Sample."

3. Open the packages that have been weighed, and mix well together the contents of each, down to one-half its depth, emptying out upon a clean floor, if needful, and crushing any soft, moist lumps in order to facilitate mixture, but leaving hard, dry lumps unbroken, so that the sample shall exhibit the texture and mechanical condition of the fertilizer.

4. Take out five)5) equal cupfuls from different parts of the mixed portions of each package. Pour them (15 in all) one over another upon a paper, intermix again thoroughly but quickly to avoid loss or gain of moisture, fill a jar from this mixture, close tightly, *label plainly*, and send, charges prepaid, to

AGRICULTURAL EXPERIMENT STATION,
Madison, Wisconsin.

The object of these instructions is to insure that the sample sent shall be a fair representative of the lot sampled.

The Station also furnishes the following

FORM FOR DESCRIPTION OF SAMPLE.

Station No................ Received at Station..............................18..

Each sample of Fertilizer sent for gratuitous analysis must be accompanied by one of these forms, with blanks *below* filled out fully and legibly.

The filled out form, if wrapped up with the sample, will serve as a label.

Send with each sample a specimen of any printed circular, pamphlet, analysis, or statement that accompanies the fertilizer or is used in its sale.

Brand of Fertilizer..

Name and address of Manufacturer...

....

Name and address of Dealer from whose stock this sample is taken.......

....

Date of taking this sample ....18..

Selling price per ton or hundred, bag or barrel...........................

Selling weight claimed for each package weighed........................

Actual weght of packages opened...

Here write a copy of any analysis or guaranteed composition that is affixed to the packages.

....

....

....

Signature and P. O. address of person taking and sending sample.

....

....

The filled-up form is preserved in the records of the Station along with the analysis of the fertilizer, and serves as a voucher for the authenticity of the sample.

One needs but little reflection to perceive the necessity that the Station is under of using every means to insure the genuineness and fairness of the samples examined by it. The profitable manufacture of fertilizers requires the investment of considerable capital and the building up of a reputation for honesty and fair dealing. The publication of a single analysis reflecting on the quality of the goods might work great damage to innocent parties. On the other hand, if the samples were better than the goods, as great or greater damage might be done to purchasers.

The above instructions are intended to secure fair sampling. In justice both to himself and to the maker, the consumer should take his samples *immediately on receipt of the goods*, as small lots of fertilizers are liable to change somewhat in value on standing, frequently to the advantage of the maker, especially if contained in bags. Moreover, such samples when taken should be sent to the Station *at once*, in order that, if they are liable to further change, they may be properly preserved. Samples should always be placed in *air-tight* vessels of *glass* if possible; Superphosphates, particularly, should never be sent in metallic vessels.

In general, fertilizers should be bought upon a guarantee as to the amount of valuable substances which they contain. High-priced fertilizers (those costing from $30 to $80 per ton, or more) depend for their trade value upon the amounts of three substances which they contain, viz.: nitrogen, potash and phosphoric acid, the latter in the three forms of "soluble," "reverted" and "insoluble." Reputable manufacturers will always guarantee their fertilizers to contain certain amounts of these substances, and the payment for the goods should be made to depend upon the fulfilment of the guarantee.

Still better would it be if all fertilizers were bought, as they are in the wholesale trade, on the basis of chemical analysis. On this plan, the buyer of a ton of fertilizer would agree to pay, not so many dollars for the ton as a whole, but so many cents per pound for every pound of nitrogen, phosphoric acid and potash which that ton contained as shown by a chemical analysis. For example, let us suppose the fertilizer to be a dried blood and that the agreement is that the price of the nitrogen which it contains shall be eighteen cents per pound, and of the phosphoric acid six cents per pound. A chemical analysis shows that the sample contains.

Nitrogen	10 per cent.
Phosphoric acid	4 per cent.

One ton (2,000 lbs.) would, then, contain 200 lbs. of nitrogen and 80 pounds of phosphoric acid. These, at the above prices, would amount to $36 for the nitrogen and $4.80 for the phosphoric acid, or together $40.80 for the ton of fertilizer, and this price would be paid accordingly.

The advantages of this method of buying are that the buyer pays for the valuable elements of the fertilizer, that he pays for exactly what he gets and knows exactly what he gets, and that he is able to compare directly the prices asked by different dealers. The method is advantageous to both buyer and seller, and the Station will gladly aid, to the extent of its power, all desirous of buying or selling in accordance with it. The following table of trade values may also be of aid to any such.

The average market prices per pound of the ordinarily occurring forms of nitrogen, phosphoric acid and potash as found in eastern markets in the spring of 1886 are the following:

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	Cents.
Nitrogen in ammonia salts	18½
Nitrogen in nitrates	18½
Nitrogen in dried and fine ground fish	17
Organic Nitrogen in guano, dried and fine ground blood and meat	17
Organic Nitrogen in cotton seed and linseed meal and in castor pomace	17
Organic Nitrogen in fine ground bone	17
Organic Nitrogen in fine medium bone	15
Organic Nitrogen in medium bone	13
Organic Nitrogen in coarse medium bone	11
Organic Nitrogen in coarse bone, horn shavings, hair and fish scrap	9
Phosphoric Acid, soluble in water	8
Phosphoric Acid, soluble in ammonium citrate	7½
Phosphoric Acid, insoluble, in dry fine ground fish and in fine bone	7
Phosphoric Acid, insoluble, in fine medium bone	6
Phosphoric Acid, insoluble, in medium bone	5
Phosphoric Acid, insoluble, in coarse medium bone	4
Phosphoric Acid, insoluble, in coarse bone	3
Phosphoric Acid, insoluble, in fine ground rock phosphate	2
Potash as high grade sulphate	5½
Potash as kainite	4½
Potash as muriate	4¼

Corresponding figures for western markets are not yet available.

It should be added that the cost of mixed fertilizers is usually higher than that of the raw materials given above. The difference between the two will represent the manufacturer's expenses in converting the raw materials into the manufactured articles. These expenses include grinding and mixing, bagging or barreling, storage and transportation, commission to agents or dealers, long credit, interest on investment, bad debts, and finally profits.

So soon as possible these trade values will be replaced by others drawn from a review of western markets.

GLUE FACTORY REFUSE.

Five samples of this sort of material have been analyzed, although only one of them was sold under that name. They were as follows:

Station No.	Maker.	Description.	Makers' Brand.	Price per ton.
1	Carbon Chemical Works Janesville, Wis.	Bone Ash	Tobacco Fertilizer.	$40.00
2		Bone Ash	Tobacco Fertilizer.	60.00
4		Bone Ash	Tobacco Fertilizer.	50.00
3		Bone and meat	Tobacco Fertilizer.	30.00
6	Reinike, Milwaukee	Bone and meat	....	11.00

Numbers 1–4 were sampled and sent by the maker; No. 6, by C. A. Schulpius, Williamsburg Station, Milwaukee.

The value of such fertilizers as these depends upon the amounts of two substances, viz., nitrogen and phosphoric acid, which they contain. In the following table the percentage of each of these ingredients found by analysis is given. The amount of water contained in the fertilizers is also given for comparison.

	Water. Per cent.	Nitrogen. Per cent.	Phosphoric acid. Per cent.
No. 1..................................	5.70	2.29	2.50
No. 2..................................	3.17	0.36	18.72
No. 4..................................	2.51	1.42	22.27
No. 3..................................	6.60	5.58	11.80
No. 6..................................	5.55	3.45	15.66

The mechanical condition of none of these fertilizers is satisfactory. Nos. 1 and 2 are coarse powders, and Nos. 3, 4 and 6 consist chiefly of large lumps of bone and refuse. A thorough grinding would greatly improve them all, both as regards the ease and thoroughness with which they can be mixed with the soil and in the promptness of their action on crops. A large lump of bone or bone ash may lie many years in the soil without undergoing much change, while the same material in a fine powder would be dissolved and taken up by crops within a much shorter time.

Nos. 1, 2 and 4 are classed above as bone ash. Good bone ash should contain little or no nitrogen and 30 to 35 per cent. of phosphoric acid. It is evident that all these samples are mixed with more or less nitrogenous matter, as is shown by the amount of nitrogen which they contain; and also with some inert material, as is shown by the relatively low percentage of phosphoric acid. The addition of nitrogenous matter to the bone ash is simply the substitution of one fertilizing element for another. The addition of inert matter, of course, reduces the percentage of the valuable ingredients and increases the amount of the fertilizer which must be handled and transported in order to obtain a given quantity of phosphoric acid or nitrogen.

Bone ash is a fertilizer which acts very slowly, being comparatively insoluble, and it is not to be recommended for general use unless it has been treated with acid and thus converted into a superphosphate. When finely ground it becomes gradually available in the soil, and if it could be bought at a sufficiently low price its use might prove profitable, but it is always an investment for a long period at a low rate of interest.

Nos. 3 and 6 consist of fragments of raw bone and apparently of cartilage and other refuse from the manufacture of glue. Were they finely ground they would be good fertilizers, worth, probably, $30–35 per ton, but in their present very coarse condition they can only be recommended for composting. In the following table is given the cost of nitrogen and phosphoric acid per pound in the above fertilizers computed in the manner explained on previous pages. For comparison there is also given the cost per pound of nitrogen and phosphoric acid in forms at least equally valuable on the basis of the trade values of 1885, the year in which the fertilizers were offered for sale.

NUMBER.	ONE POUND OF NITROGEN.		ONE POUND OF PHOSPHORIC ACID.	
	Costs.	Is worth.	Costs.	Is worth.
	Cents.	*Cents.*	*Cents.*	*Cents.*
1	60.8	10	24.2	4
2	38.2	10	15.3	4
4.	14.5	10	5.8	4
3	24.3	10	9.7	4
6	5.7	10	2.3	4

In all except No. 6, the fertilizing ingredients cost very much more than they can be bought for in standard fertilizers, which, in addition, would usually be in better mechanical condition and adapted for immediate use.

Nos. 1–4 are called by the manufacturer tobacco fertilizers. They are as well adapted to tobacco as to any other crop and as well to any other crop as to tobacco. The idea that fertilizers can be compounded which shall be specially suited to the requirements of particular crops, though a favorite one with manufacturers, is nevertheless an erroneous one, based on an imperfect understanding of the relations of soil, crop and fertilizer.

SUPERPHOSPHATE.

One sample of these goods has been examined, viz.: Garden City Phosphate, manufactured by the Northwestern Fertilizing Co., of Chicago, and sampled and sent to the Station, by Paul Lachmund, Sauk City. Price per ton, $30.

Analysis

	Pounds per 100	Cost per pound.	Value per pound.
		Cents.	*Cents.*
Nitrogen	2.22	20.2	18
Soluble phosphoric acid	5.38	10.0	9
Reverted phosphoric acid	3.17	8.9	8
Insoluble phosphoric acid	4.29	5.0	6
Potash (as muriate)	0.55	4.7	4

Although the cost per pound of the valuable ingredients of this fertilizer is slightly higher than the estimated value per pound, it must be remembered that these values, as noted on page 129, are simply the market cost of *unmixed* raw materials. The price of mixed fertilizers usually shows a much greater excess over the price of the raw materials than it does in this case.

LAND PLASTER.

Four samples of land plaster have been examined, viz:

No. 7—Sandusky land plaster, manufactured by Marsh & Co., $7.50 per ton.

No. 8—Bay Settlement land plaster, manufactured by M. M. Braus, $2.00 per ton.

No. 9—Buffalo land plaster, manufactured by Sherman Bros., $1.25 per barrel.

All were sold by F. Hurlbut, of Green Bay, and were sampled and sent to the Station by R. B. Kellogg, of Green Bay.

No. 11—Michigan plaster, ground and sold by Wm. Ellwell, Sheboygan. $5.50 per ton.

Sampled and sent to the Station by Hon Hiram Smith, Sheboygan Falls.

Analyses.

	No. 7.	No. 8.	No. 9.	No. 11.
Insoluble in acid	0.40	58.61	5.83	1.25
Pure plaster	96.27	None	76.35	96.85
Undetermined	3.33	41.39	17.82	1.90
	100.00	100.00	100.00	100.00

Sample No. 8 is not land plaster at all. While not absolutely worthless, its manurial value is too small to be worth considering. As a substitute for plaster it is valueless. Of the other samples, No. 9 is of fair and Nos. 7 and 11 of excellent quality. Assuming No. 9 to weigh 300 lbs. per barrel, it costs, $8.33 per ton, and we have the following as the relative value of the samples:

	No. 7.	No. 8.	No. 9.	No. 11.
Pure plaster in one ton	1925.4 lbs.	None	1527.0 lbs.	1937.0 lbs.
100 lbs. of pure plaster cost	39 cts.	....	54½ cts	28½ cts.
$1.00 buys of pure plaster	256 lbs.	None	193 lbs.	352 lbs.

MISCELLANEOUS CHEMICAL AND OTHER WORK

By H. P. Armsby.

As in previous years, a large part of the work of the chemical laboratory of the Station has consisted in the execution of the numerous analyses of fodders, dung, milk, skim-milk and butter required in the foregoing feeding experiments.

During the past twelve months, however, the calls upon the Station for the chemical examination of fertilizers and other materials have begun to increase in number, while at the same time it has been found desirable to do some purely chemical work in testing methods of analysis or of sampling. The results of the analyses of feeding-stuffs and fertilizers have been given on previous pages; below may be found some account of the miscellaneous work of the chemical laboratory.

Summary of Chemical Work—It may be of some interest in this connection to present a statement of the amount of work of all kinds done in the laboratory during the year. The following summary includes the analyses mentioned on p. 101.

	Samples.	*Single determinations.*
Fodders and fodder residues	101	476
Dung	16	128
Milk	270	621
Skim-milk	192	215
Butter-milk	3	6
Butter	111	134
Fertilizers	10	29
Miscellaneous work		173
Total	703	1,782

Nearly all these determinations were made by the chemists of the Station, Messrs. Short and Woll, Mr. Short having been employed during the entire year and Mr. Woll during about seven months.

ERRORS OF ANALYSIS.

If a skilled marksman shoots a number of times in succession at a target, he finds that, however carefully he may aim, no two balls strike the target exactly in the same place, and it is a matter of pure chance which particular ball, if any, hits the bull's-eye. In the same way, however carefully the chemist may make his determinations, it is a matter of pure chance which particular one, if any, comes out exactly right, or if any two determinations agree exactly with each other. But just as the skillful marksman will put all his balls within a certain distance of the bull's-eye, depending upon the range, the quality of his weapon and other conditions, so the skillful chemist will bring his results very near the truth, the approximation depending upon the nature of the method used.

It is a matter of some importance in interpreting the figures obtained in an experiment to know to what error the processes of analysis which have been used are liable. This may be ascertained by making a number of determinations upon the same sample. By a simple mathematical calculation, the principle of which need not be explained here, we can then compute what is called the "probable error" of the results. Thus if we find by a certain method 2.48 per cent. of nitrogen, with a probable error of 0.03 per cent., this means that it is an even chance that the result obtained differs from the truth by 0.03, or in other words, that it is unlikely that the true percentage is greater than 2.51 or less than 2.45.

Below are given the results of calculations of the probable error of some of the more important determinations in the analysis of fodders and dairy products.

Fodder analysis. Twelve determinations each of dry matter, crude fiber, and nitrogen by soda-lime process, and eleven determinations of nitrogen by Kjeldahls' method, were made in a sample of wheat bran, and eleven determinations of net ash in a sample of corn fodder.

The results were as follows:

DRY MATTER. (At 110° C.)	CRUDE FIBER. (Uncorrected for Nitrogen or Ash.)	ASH.	NITROGEN.	
			Soda lime.	Kjeldahl.
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
85.94	9.60	4.68	2.49	2.54
85.69	10.61	4.72	2.53	2.52
86.13	10.40	4.81	2.37	2.52
86.17	10.48	5.14	2.34	2.45
86.04	10.05	4.05	2.37	2.48
85.83	10.40	4.69	2.33	2.47
85.80	9.94	5.31	2.53	2.40
85.89	10.47	5.50	2.42	2.45
85.89	10.35	4.43	2.46	2.47
85.72	10.53	4.41	2.44	2.52
85.61	10.11	4.47	2.49	2.46
85.70	10.68	....	2.35	....
Average, 85.87	10.31	4.80	2.43	2.48

Probable Error of a Single Determination.

	Dry matter	Crude fiber.	Ash.	Nitrogen.	
				Soda lime.	Kjeldahl.
Per cent. of fodder.	0.12	0.22	0.29	0.052	0.026
Per cent. of ingredient determined...	0.14	2.13	6.04	2.14	1.07

The probable error of the average of any number of determinations is found by dividing the errors given above by the square root of the number of determinations.

These figures are strictly applicable only to the fodder (bran) experimented upon and to analyses made exactly after the methods followed by us. It would be very desirable to repeat these trials, and to extend them to other fodders.

Milk and butter analysis. Determinations have also been made by the errors incurred in the analysis of dairy products as follows:

MILK.		SKIM-MILK.		BUTTER.	
Solids.	Fat.	Solids.	Fat.	Water.	Fat.
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13.71	3.75	10.46	0.90	12.70	86.62
13.41	3.72	10.44	0.95	12.57	83.49
13.48	3.73	10.36	1.06	12.63	83.62
13.46	3.77	10.22	0.83	12.72	83.46
13.53	3.89	10.52	0.84	12.64	83.21
13.48	3.90	10.52	0.90	12.72	83.57
13.19	3.75	10.22	0.97	12.73	82.96
13.30	3.73	10.24	0.95	12.64	83.43
13.20	3.78	10.41	0.60	12.72	83.29
13.26	3.82	10.44	0.72	12.68	83.31
13.43	....	10.35	0.78	12.61	83.33
Average, 13.35	3.78	10.38	0.86	12.67	83.55

Probable Error of a Single Determination.

	MILK.		SKIM-MILK.		BUTTER.	
	Solids.	Fat.	Solids.	Fat.	Water.	Fat.
In per cent. of substance analyzed.............	0.11	0.042	0.076	0.087	0.036	0.70
In per cent. of ingredient determined...........	0.84	1.11	0.73	10.12	0.29	0.84

Analytical Methods—The following are, in brief, the analytical methods used in making the above determination. In the fodders, dry matter was determined by drying two grams at 110° C. in a current of dried illuminating gas, ash by burning at a low temperateture and deducting CO_2 and char, crude fiber substantially by the modified Weende method of Wattenberg.*

In the dairy products, solids were determined by drying about 2 grams upon asbestos in Hofmeister capsules at a temperature of 110° C. for about 3–4 hours, in an air bath. The fat was extracted from the dry residue with anhydrous sulphuric ether.

Sampling of Butter. A practical difficulty in butter analysis lies in the fact that the water is not uniformly distributed through the butter, but collected in little drops. Consequently, in weighing out the small quantity required for an analysis it is very easy to include too much or too little water, and duplicate analyses upon the same sample seldom agree well. If, to avoid this difficulty, a larger amount of butter is weighed out, the difficulty of drying it completely without decomposing some of the fat increases greatly. These difficulties are entirely avoided, however, by the use of the following method of sampling, devised by Dr S. M. Babcock, chemist of the New York Agricultural Experiment Station, and communicated verbally by him to the writer.

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*Jour. f. Landw., xxviii, 273.

Enough butter is taken to fill a quart fruit jar about one-third full when melted, and the butter is melted by placing the jar in hot water. The cover of the jar is then securely fastened on and the whole is thoroughly shaken until the contents are converted into what might be described as an emulsion of water in melted fat. The jar is cooled (by means of ice-water when convenient) with frequent shaking until the contents have solidified. The water is then found to be uniformly distributed throughout the mass, and samples of one or two grams will give concordant results. The results just given for the probable error of butter analysis show the degree of accuracy which may be easily attained.

DISTRIBUTION OF THE FAT OF MILK IN BUTTER MAKING.

It is a matter of considerable importance to the dairyman to know what proportion of the fat of the milk he can recover in butter and how much remains in the skim-milk and butter-milk, and, furthermore, whether this proportion is affected by the use of different feeds, or by different methods of handling the milk. The results of some experiments on the loss in skim-milk have already been given. (page 118). Three trials have also been made in which both the milk and all the products (skim-milk. butter-milk and butter) were weighed and analyzed. The experiments were made upon mixed milk, the milk being set in Cooley cans for eleven hours, and the cream, after becoming slightly sour, being churned in a rectangular churn. Each churning was of the cream from three days' milk. The samples of milk and skim-milk were taken exactly as in the feeding experiments reported on page 97, *et seq.* The following are the details of the experiments:

First Trial.

MILK.				PRODUCTS.				
Date.	Am'nt	Per ct. of fat.	Am'nt. of fat.		Date.	Am'nt.	Per ct. of fat.	Am'nt. of fat
	lbs.		*lbs.*			*lbs.*		*lbs.*
October 6...	54.13	4.21	2.28	*Skim-milk*	Oct. 6.	42.75	0.59	0.25
7...	53.00	4.53	2.40		7..	43.31	0.79	0.34
8...	53.50	4.50	2.41		8..	43.00	0.64	0.28
				Total		....	....	0.87
				Buttermilk and washings		64.00	1.75	1.12
				Butter		6.10	81.93	5.00
Total fat of milk.....	....	....	7.09	*Total fat of products*.........	....	....	......	6.99

Second Trial.

MILK.				PRODUCTS.				
Date.	Am'nt.	Per ct. of fat.	Am'nt. of fat.		Date.	Am'nt.	Per ct. of fat.	Amn't of fat.
	lbs.		*lbs.*			*lbs.*		*lbs.*
October 9..	57.13	4.03	2.30	*Skim milk*.........	Oct. 9	45.63	0.53	0.24
Ootober 10..	54.50	4.17	2.27		Oct. 10	44.06	0.75	0.33
October 11..	52.50	4.10	2.15		Oct. 11	42.56	0.65	0.28
				Total	....	....	......	0.85
				Butter-milk and washings........	......	73.25	0.57	0.42
				Butter............	....	6.25	90.67	5.67
Total fat	*of milk*	....	6.72	*Total fat of products*....	....	....	....	6.94

Third Trial.

MILK.				PRODUCTS.				
Date.	Am'nt.	Per ct. of fat.	Am'nt of fat.		Date.	Am'nt	Per ct. of fat	Am'nt of fat.
	lbs.		*lbs.*			*lbs.*		*lbs.*
October 12..	52.25	3 87	2.02	*Skim-milk*.........	Oct 12	42.50	0.55	0 23
October 13..	53.75	4.15	2.23		Oct. 13	44.06	0.52	0.27
October 14..	49.25	4.30	2.12		Oct. 14	39.75	0.99	0.39
				Total	....	....	....	0.89
				Butter-milk and washings.........	....	70.75	1.80	1.27
				Butter.	....	5.75	84.26	4.84
Total fat	*of milk*	....	6.37	*Total fat of products*.............	....	....	....	7.00

As was to be expected, the total fat found in the products does not exactly agree with that found in the milk, owing to unavoidable errors of weighing, sampling and analysis. If we take the average of the three trials, and distribute the errors among the several products in proportion to the amount of fat they contained, we find that for every hundred pounds of fat contained in the milk there was found

In the skim-milk...	12.48 pounds
In the butter-milk	13.43 pounds
In the butter.	74.09 pounds
	100.00

These experiments show a large loss of fat in the skim-milk and butter-milk, but they are too few in number to generalize from. I have no doubt that far better results are usually reached, both in our own dairy and in good dairy practice generally. That a very much larger proportion of the fat may be recovered under favorable conditions has already been shown in previous pages (compare pages 118 to 122).

These experiments were not made for the purpose of ascertaining the proportion of fat recovered, but as a preliminary trial to ascertain how accurately such experiments could be made. If we take account of the probable errors of analysis as computed on p. 138, indicating by the sign ± (plus or minus) the error to which each number is liable, we get the following balance between the fat of the milk and of the products.

First Trial.

Fat of milk	7.9±0.046	Fat of skim-milk	0.87±0.051
		Fat of buttermilk	1.12±0.112
		Fat of butter	5.00±0.042
		Total	6.99±0.130

Second Trial.

Fat of milk	6.72±0.043	Fat of skim-milk	0.85±0.049
		Fat of buttermilk	0.42±0.042
		Fat of butter	5.67±0.048
		Total	6.94±0.081

Third Trial.

Fat of milk	6.37±0.041	Fat of skim-milk	0.89±0.053
		Fat of buttermilk	1.27±0.127
		Fat of butter	4.84±0.041
		Total	7.00±0.144

In the first trial all the discrepancy is covered by the errors of analysis, and in the second trial a large portion of it is. In the third trial, the discrepancy is much greater than the errors of analysis. On the whole it would appear that, with care in sampling, the distribution of the fat of the milk may be followed with a good degree of accuracy.

BUTTER ADULTERATION.

A sample of butter suspected of adulteration with foreign fats was received January 29th from J. M. Fish, of Springfield, Wisconsin. An examination by Koettsdorfers method showed the sample to be pure butter and it was so reported to Mr. Fish. A number of other samples of butter and butterine are now under examination and will be reported upon later.

BUTTER POWDER.

D. D. Jones, of Fond du Lac, Wisconsin, sent to the Station, February 4th, a sample of a powder which parties had offered to him for the purpose of hastening the churning of cream or milk. Examination showed it to consist of common alum and Mr. Jones was written to as follows:

> The butter powder proves to be common alum. This substance was recommended about forty-five years ago, and is said to hasten the churning of cream. It would not be harmful if used in small quantity; if too much were used, it would probably make the butter inedible.

BUTTER TESTS OF COWS.

The following circular was sent early in November to all the newspapers in the state:

> MR. EDITOR: The general interest now felt in butter tests of cows, and the fact that the large yields reported are regarded with suspicion by many, renders it very desirable that every precaution should be taken to ensure the utmost accuracy in such tests, to the end that their results may command public confidence.
>
> Among other things, chemical analysis may render important aid in this direction by showing the quality of the milk used and the composition of the butter produced.
>
> The Experiment Station is ready to aid in this way, to the extent of its ability, all persons in the state desirous of testing cows. Whenever possible, it will, on request, send a competent person to be present during the test and take samples for analysis, and will analyze these samples and report the results to the owner of the animal, provided he will bear a fair proportion of the expenses. No charge will be made for the analyses. Correspondence on this subject should be addressed to the undersigned.
>
> H. P. ARMSBY,
> *Prof. of Agricultural Chemistry,*
> *Agricultural Experiment Station, Madison, Wis.*

The circular was extensively copied by the press of the state. No responses have yet been received.

INSTITUTE EXHIBIT.

During the fall of 1885 an exhibit was prepared for use at the Farmer's Institutes held during the winter, showing to the eye the composition of some of the more common fodders and dairy products. Through the kindness of the superintendent of Institutes, Mr. Morrison, bottles for the samples were provided, and the expenses of transportation were also paid from the Institute fund. The exhibit attracted general attention at all the meetings, and at the close of the series was deposited in the superintendent's office for permanent exhibition.

WEEDS MENTIONED IN THE WISCONSIN WEED LAW OF 1884-5, AND SEVERAL OTHER WEEDS.

By A. B. SEYMOUR.

THE WEED LAW.

[No. 617, A.] [Published April 7, 1885.]

CHAPTER 283.

AN ACT relating to the duties of overseers of highways.

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:

SECTION 1. Every person and corporation shall destroy upon all lands which he or they shall occupy or control, all weeds known as Canadian thistles, burdock, teasel, white daisy and snap dragon at such time and in such manner as shall effectually prevent them bearing seed. In like manner shall he or they also destroy any of the above mentioned weeds standing or growing as far as the center of public highway, lanes or alleys adjoining the lands owned or controlled by him or them.

SECTION 2. If the occupant of any such lands shall fail to destroy such weeds as so required, after having six days' notice in writing by the commissioner of Canadian thistles, such occupant shall be fined five dollars for the first offense, and ten dollars for each offense thereafter.

SECTION 3. There shall be appointed by the town supervisors of each town or by the city council of any city as the case may be, some competent person styled "commissioner on Canada thistles," who shall be required to take the same oath as town officers, and shall hold his office for one year and until his successor is appointed and qualified. The board may for any good cause remove said commissioner and appoint a successor to serve during the unexpired term.

SECTION 4. The commissioner shall carefully inquire concerning the existence of noxious weeds in his township or precinct, and in case any person, persons or corporation occupying or controlling any lands within this state shall neglect to destroy any Canada thistles, burdock, teasel and snap dragon growing on any lands owned or controlled by him or them, or on any highway, lane or alley adjoining such lands, it shall be the duty of the commissioner to destroy, or cause to be destroyed, all such weeds. He shall spend as many days as the supervisors or city council may deem necessary, and for each day so spent shall receive one dollar and a half per day and one-half of all fines collected, upon presentation of his account therefor verified by his oath and specifying by separate items against each piece of land, describing the same; and the respective amounts shall be placed on the next tax roll in a separate column headed for "destruction of weeds," as a tax against the lands upon which such weeds were destroyed, and be collected as other taxes.

SECTION 5. It shall be the duty of the chairman of every town board at the annual town meeting of each year to read aloud to such meeting the whole of this act.

SECTION 6. All previous acts in relation to noxious weeds and all amendments thereto are hereby repealed.

SECTION 7. This act shall take effect and be in force from and after its passage and publication.

Approved April 3, 1885.

Any writing intended to be read and understood by all people, should if possible be written in words familiar to all, and technical terms should be excluded or explained. This is especially true for so important a document as a weed law, which may affect the interests of every farmer and land owner in the State. The law-makers of Wisconsin are to be commended for their good intention in this regard, but while in the weed law they excluded scientific names, they used for the weeds common names, which have to their readers an uncertain meaning, and mean different things to different persons. So instead of clearness they produced obscurity and confusion. The use of the name Snapdragon in the law is entirely wrong. The true Snapdragon is never a weed in Wisconsin. Probably Toad-Flax (*Linaria vulgaris*) was meant.

Many persons have been in doubt as to what the law meant by Teasel. The true Teasel is not common and is unknown to most persons. Many thought that the Cocklebur (*Xanthium*) was meant. The Daisy Fleabane (*Erigeron*) appears to be taken by some for White Daisy.

In general, the common names of plants are carelessly used and have indefinite and variable meanings. To one person a certain name means one plant, to another, another plant. Names are very differently used in different parts of the country. The same plant has different names in different places.

There has been much discussion through the state about the meaning of the weed law, and some difficulty has resulted from its obscurity. The scientific name always determines the plant with certainty. If a botanist had been consulted and the correct scientific name inserted together with the common name, the law would have been just as plain to every person and any question that might arise could be settled at once by any good botanist. As it stands now, the best botanist can do no more than conjecture in one case, and the average reader is unable to understand the law.

The weeds that most need to be exterminated in Wisconsin are:

Canada Thistle (*Cirsium arvense,* Scop.).
Common Thistle (*Cirsium lanceolatum,* Scop.).
Burdock (*Lappa officinalis.* All.).
Ox-eye Daisy (*Leucanthemum vulgare,* Lam.).
Cocklebur (*Xanthium strumarium* L.).
Beggar's Lice (*Cynoglassum Uorisoni,* D C.).
Couch-grass (*Triticum repens,* L.).

STRUCTURE OF THE FLOWERS OF THE COMPOSITE OR SUNFLOWER FAMILY.

The flowers in this family have a complicated structure, which needs to be explained here because the family includes so many of our weeds. Here belong the Thistles, Ox-eye Daisy, Cocklebur, Burdock, Rag-weed and many others. They were said by the old botanists to have compound flowers, but modern botanists use the term composite, instead.

In the Dandelion, a hollow stem without leaves comes up and bears what is commonly called the flower. This is not a single flower, as it appears, but a cluster of small flowers. In such plants as the Lily, Wild Rose, Apple and most of our common plants, the flowers are plainly distinct from each other and independent in structure. Each flower has a green outside covering called the calyx, then comes the colored part or corolla, and in the center are the stamens and pistils. The pistils produce the seeds, the stamens produce the dust-like pollen to fertilize the seeds.

But in the Dandelion, which may be taken to illustrate the Composite family, the flowers are very small and form a dense cluster or head. The head is surrounded by a row of green parts resembling the calyx, so that the cluster looks much like a single flower and is often called so popularly. Each of the little flowers has all the parts of any perfect and complete flower. The calyx takes a peculiar form and appears as numerous fine, white hairs, which enable the ripe seed to float in the wind. The yellow part of the flower, which is the corolla, is flattened out, strap-shaped. So there are as many flowers in the head as there are of the yellow, strap-shaped parts. At the base of each of these arise the stamens and pistils. The stamens are five, united into a tube around the pistil. The pistil has a long, slender style, projecting through the ring of stamens and two-branched at the end.

There are many variations of this structure. In many plants, including the Thistles, the calyx takes the form of slender bristles. In others there are a few teeth, which may or may not fall off easily. Sometimes the teeth are barbed and adhere to clothing, as in the Beggar-ticks or Spanish Needles (*Bidens*). The colored parts (corollas) may all be strap-shaped as in the Dandelion or all like slender tubes as in the Thistles and Iron-weed, or the central ones tubular and the outer ones strap-shaped (ray flowers) as in the Ox-eye Daisy, Sunflower and Compass-Plant (*Silphium*). They also differ as to their stamens and pistils. In the Ox-eye Daisy, all the flowers have pistils and produce seeds, but the ray flowers have no stamens. In the Sunflower, the ray flowers have no stamens and an imperfect pistil and produce no seed. In the Compass-Plant, the ray flowers have no stamens but the pistils are perfect and produce seeds; the tubular flowers have stamens, but the pistils are imperfect and produce no seeds.

In some species the staminate and pistillate flowers are on different plants or, as in the Cocklebur, in different heads on the same plant.

Three of the five weeds mentioned in the law, Canada Thistle, Ox-eye Daisy and Burdock, belong to this family.

CANADA THISTLE (*Cirsium arvense*, Scop.)

Methods of Extermination.

The Canada Thistle is universally considered the worst of weeds and is one of the most difficult to exterminate. The number of methods for extermination proposed is in proportion to the difficulty of the task, and as would be expected they are good and bad, and one that succeeds in one case fails in another. The efficacy of any method depends largely upon the intelligence, thoroughness and energy with which it is carried out.

It is well known that salt in quantity kills vegetation. It is often sprinkled on brick walks to stop the growth of grass in the crevices. The same method is applied to Thistles, but with varying results. A considerable quantity is needed.

Prof. L. H. Bailey, Jr., recommends a quarter of a pint to each plant, but says he has known it to fail as often as to succeed. If in a pasture, the cattle are always salted on the Thistle patch, the chance of success is greatly increased. If scattered broadcast, one bushel to four square rods is recommended. Or salt may be applied as strong brine poured around each plant.

There are many chemicals which would doubtless destroy the weed, one is sulphuric acid; but they are too expensive.

Seeding down and mowing frequently is a favorite and quite successful method, especially in soils that will produce a heavy sod. The sod occupies the soil and gives the thistle little opportunity to grow, while the mowing keeps them nearly deprived of green leaves. As these are essential to the production of the plant's food, the supply of nutritive material is at length used up and the thistle is starved to death. If the tops or leaves are allowed to make any considerable growth between mowings, the method is likely to prove a failure; for as soon as a green leaf appears, the supply of food to the roots is re-commenced at once. Mowing once a year does little or no good. It may prevent seeding but will not hinder much the growth of the underground stems, in which the obnoxious character of the plant so largely lies.

In one case reported, a farmer, finding a patch of Canada Thistles in his wheat field, fenced the spot and turned in some hogs. The weed was soon rooted out and he had no further trouble.

The surest and best method of all is clean culture, and culture sufficiently clean for this purpose can scarcely be made if a crop is raised at the same time; for some plants will be overlooked or grow so close to the hills of the cultivated crop that they will not be cut out. Let the crop go for one season and simply keep the weeds down. Do not allow them to make any growth above ground. The green leaves rapidly transform the elements of soil and air into fresh food materials, but without the green parts none can be supplied. If growth continues without them, the food supply stored in the subterranean portions will become exhausted and the plants must die.

Prof. L. H. Bailey, Jr., in his "Talks about Weeds," in the *American Cultivator,* writes as follows: "A summer fallow is an expeditious means of eradicating Thistles. If they are turned under deeply and completely, and the operation repeated as often as the Thistles begin to show themselves — once a month or oftener — one season will usually serve to eradicate them, especially on heavy land, where the smothering is more complete. Lighter lands should be turned oftener and deeper. The plowing must be done thoroughly, with a slow team; a balk in a furrow must be covered. Many farmers can testify to the success of this treatment."

The *New York Tribune* gives the following:

"To Mr. C. W. Palmer, of Western New York, much of the needful and beneficent discipline of life came in the common form of Canada Thistles in clover seed. Thus his farm became stocked, thirty years since, with this 'worst of weeds.' He tried many ways to get rid of them — mowing, hoeing, salting, etc. — but the plague multiplied until he had 'thistles in wheat, thistles in oats, thistles in corn, thistles in grass, thistles in everything raised.' But now his hundred acres of land, that 'five years ago was a complete mat of them' is wholly clear — the result of treatment mentioned in *The Germantown Telegraph:*

'Plough the ground in June, drag in July twice and then gang-plough three times during August two or three inches deep, harrowing the ground every time. I plough with a spring-tooth harrow. Any tool that will cut off the tops the first, second and fourth weeks in August certainly uses them up here completely. No half-way work will kill them. The tops must be cut off three times in August. A wet season is just as good as a dry one; only do it and do it well.'

"Mr. J. C. Plumb received in Wisconsin seed of Canada Thistle with a package of trees from the east, and tells *The Western Farmer* his experience in getting rid of the resulting plague-spot, by the simple process of repressing the breathing organs of the plants:

'We carefully cut, hoed and ploughed them for the next two years, when we found they had increased from a square yard to a square rod. We then cleaned off every tree and bush from the infested ground, and gave orders to every man and boy to watch that spot and not let a living plant show above ground. This was done so effectually, by looking it over once or twice a week the first summer, that only a trace of the plants was visible the next year, and before midsummer they were utterly destroyed, never to reappear. Such, and such only, can we recommend as a specific for this pest of the farm.'

And the New England *Homestead:*

"Canada thistles are one of the most easily exterminated weed pests we have. Cut at any time in hot weather and kerosene poured on the roots will kill them every time.—*C. B., Ellington, Conn.*

"Canada thistles can be killed in one year by salting stock on them for one summer. Cut them off even with the ground, put salt on every one, and as often as they appear salt again. I killed a good-sized patch in that way in one summer, and they have never showed up since.—*C. B. Jones, Delavan, Wisconsin.*"

Structure.

The Canada Thistle has a long creeping underground stem or rootstock, and it is by means of this that it forms large patches and is able to make itself so obnoxious. This rootstock lives from year to year, extending laterally in all directions and growing down below the depth of ordinary plowing. It sends up branches to the surface which bear the so-called root leaves, and finally, if undisturbed, ordinary leafy stems and flowers.

The leaves are of a brighter green and rather thin as compared with other thistles, and they are cut into numerous divisions and teeth, each of which terminates in a sharp bristle. The radical leaves are the larger. Those developed after the Thistle has been cut down are apt to be unusually large and luxuriant; one not familiar with this fact, might be in doubt about the identity of the plant. The stems grow from one to three feet high and the branching top bears numerous heads of purple flowers.

The Common Thistle (*Cirsium lanceolatum*), has sometimes been mistaken for the Canada Thistle in regions where the latter does not occur; but the two are so unlike that after once seen they can never be mistaken for each other. The Common Thistle is usually much the larger and stouter and has prickly ridges or "wings" running down the stem from the bases of the leaves. The heads of purple flowers are larger and armed with strong prickles, and the leaves are armed with very strong prickles. It lives two years and produces its flowers the second year. It is a very undesirable plant and should be exterminated, but it is neither so troublesome nor so difficult to deal with as the other.

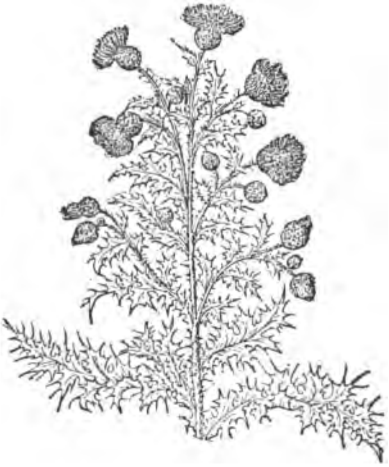

Fig. 1. Canada Thistle (*Cirsium arvense*).

The Canada Thistle differs in its smaller size, smooth stems, weaker prickles, and the heads of the flowers are smaller and less prickly than those of any other thistle in this country.

There are several other kinds of thistles, but none are very common unless it be the *Cirsium discolor*, which has the under surface of the leaves white with wooly hairs.

Dissemination.

The Canada Thistle spreads locally by means of its running rootstocks. It may spread from a single plant and at length cover a whole field. In the heavy prairie soils of our western states it spreads more slowly than in the lighter, more sandy soils of the east, hence it is much less troublesome here. Cutting the rootstocks hastens the spreading, since it makes so many independent plants. Some of the pieces may be carried by the plow to a new place. Each piece grows with vigor, and thus for each break there is a new plant. Latent buds are forced into activity and new stems and leaves are formed.

A hundred years ago William Curtis, of London, gave the following account of an experiment with Canada Thistle or Field Thistle, as it is called in England. "I planted in a garden a piece of the root of this Thistle, about the size of a goose quill, and two inches long, with a small head of leaves, cut off from the main root as it was springing out of the ground. This was done on the first of April; by the second of November following, this small piece had thrown out shoots several of which had extended themselves to the distance of eight feet. Some had even thrown up leaves five feet from the original root. Most of the shoots were about six inches under ground; others had penetrated to a depth of two and a half feet. The whole together, when dug up and washed from the earth, weighed four pounds. In the spring following it again made its appearance, on or about the spot where the original piece was planted. There were between fifty and sixty young heads, which must have sprung frem the roots that had eluded the gardner's search, though he was particularly careful in extracting them."

A Thistle head is not a single flower, but a cluster of numerous small flowers. Each has a long and slender tubular corolla with five slender lobes at the top representing the fine petals. Each flower, when fertile, produces one seed and therefore a fertile head of flowers produces many seeds. Professor Brewer estimates that a single plant may produce ten thousand seeds.

But it is well known that the Canada Thistle has two kinds of flowers which occur on separate plants. Professor Bailey found that one kind produces thick or bushy heads in which the flowers have perfect stamens but imperfect pistils, and only occasionally produce a seed. The other produces more slender heads in which the pistils are perfect and the stamens imperfect. These may produce seeds if there are any of the other kind in the vicinity to furnish pollen to fertilize them. The staminate form seems to be the commoner and seeds are seldom found. The only way in which the Thistle is likely to be brought from distant places is by means of seeds, and this must occur less frequently than is usually believed; yet it does occur. Cases are reported where the seed is brought in straw, clover seed, a shipment of trees, etc., and there are endless ways in which it may occur when the seeds are produced.

History.

The Canada Thistle has been a weed in Europe for centuries. How it was brought to America is unknown, but the fact that it came to the eastern states from Canada is unquestioned. The first mention of it in the Uuited States was found by Professor Bailey to be in the unpublished diary of Pursh, a well-known Siberian botanist, who traveled in this country during the first decade of this century. He records it (entirely new to him) at the lower end of Lake Champlain in 1807, and afterwards mentions it as occurring at Rutland, Vermont. By 1814 it had spread southward to New York city and eastward to Boston. In 1828 it reached Chester county, Pennsylvania. where it was introduced in Timothy seed; but it did not spread so rapidly there as further north. Since that time it has become distributed over the northern states.

BURDOCK (*Lappa officinalis,* All.).

No other plant is ever known to be mistaken for this one. It is a large, coarse weed, growing from two to four or even six feet high. The germinating seed grows the first year into a strong plant, but produces no flowers. The stem dies down after having stored up a large amount of food material in the roots for the second year's growth. The second year it makes a vigorous growth from this root, produces flowers and seeds, then dies, root and branch. During growth the stout stem branches, forming a bushy mass of vegetation. The root leaves are very large, one or two feet long and half as broad or more, with a toothed and wavy margin. The leaves on the stem are gradually smaller toward the top. The under surface is covered with cobwebby hairs.

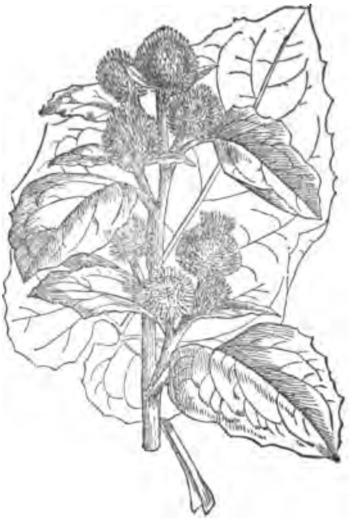

Fig. 2. Burdock (*Lappa officinalis*).

It belongs to the Composite family and has the flowers clustered in dense heads surrounded by scales. The head contains numerous little tubular purple flowers, all alike and perfect. The scales forming the involucre around the outside of the head are numerous and closely appressed at the base, but with slender, bristle-like spreading tips, each of which is curved inward at the end, forming a hook. Thus the whole head appears like a rounded, rough, prickly bur.

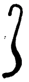

Fig. 2a. One of the hooked scales.

It is especially on account of the hooks that it is so obnoxious, as they adhere to clothing, hair of cattle or wool of sheep. Often in removing them many of the hooks pull loose from the plant and still adhere to the clothing, continuing their irritation.

Besides this the weed is coarse and unsightly, and will overshadow and crowd out any desirable vegetation. The leaves are sometimes applied as a remedy for headache. The root is used in medicine.

Burdock is not a difficult weed to extérminate, and its presence in waste places or barnyards indicates careless neglect.

It may be easily exterminated. It is propagated by seed, and seeding may be easily prevented. The root lives only two years; therefore, if it is not allowed to seed, it will soon die out. It will not flourish even the second year if it is kept cut down the first. It is apt to be neglected the first year because it produces only leaves. These are small at first, so that it does not look formidable. At that time it is easily destroyed. In any case cut deep enough to remove all of the portion which bears the leaves at the surface of the ground and part of the root itself.

WILD TEASEL (*Dipsacus Sylvestris*, Mill).

Some have thought that the name Teasel in the weed law was intended for Cocklebur, (*Xanthium strumarium*), and it was doubted whether the true Teasel occurs as a weed in Wisconsin; but reliable observers report that it does. The misunderstanding has made considerable confusion. The name can never be rightly applied to Cocklebur.

The Teasel may be recognized by the following characters: It is a coarse and stout herb, a biennial, growing from the seed the first year without flowers, the root living over winter, producing flowers and seeds the second year, after which it dies. The plant is prickly throughout on stems and leaves. Few of our herbaceous plants have prickly stems. The leaves are oblong, lance-shaped, much longer than broad and tapering but slightly upward and without leaf stalks. They are opposite, in pairs, on the stem and the bases are often united around it.

The flowers are small, pale purple, many collected together in a dense egg-shaped cluster or head similar in structure to the heads in the Composite family, to which the Teasel family is related. Within the cluster by the side of each small flowre, is a scale which tapers into a slender point projecting beyond the flower, so that the head is bristly all over. At the base of the head, outside, is a circle of stiff leaves forming an involucre, projecting and curved upward. They are of unequal length and prickly like the stem.

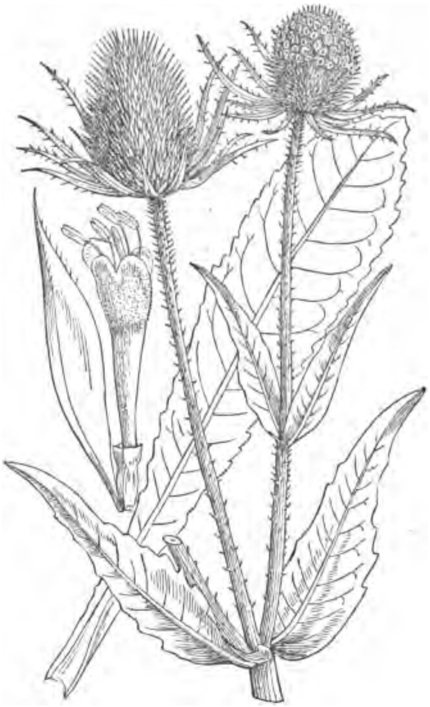

Fig. 3. Wild Teasel (*Dipsacus sylvestris*).

This plant has been reported in several localities and in some it has been exterminated. There is no reason to believe that it is common, but the reverse. Where introduced it is likely to become troublesome and should be killed out at once. This is not difficult. It is a native of Europe and is here only as an intruder.

COMMON COCKLEBUR (*Xanthium strumarium,* L).

It has been thought by some that the name Teasel in the weed law meant this plant, but this is probably an error, since the true Teasel occurs as a weed in the State and Cocklebur can never be rightly called Teasel.

Cocklebur is a very common weed, while Teasel is rare; the former is rank and troublesome and well deserves to be outlawed. Its fruit is very troublesome also, being covered with hooked prickles.

It is believed by Dr. Gray to exist in this country both native and naturalized from Europe. It is the introduced stock that grows in cultivated fields, barnyards and roadsides and is troublesome as a weed. The native plant grows along river banks. The root lives but one year, the growth is rank, the stem coarse, branching irregularly, one to three feet high, and sometimes reported even higher. The leaves are broadly triangular in general outline, more or less toothed and lobed, borne or long leaf-stalks.

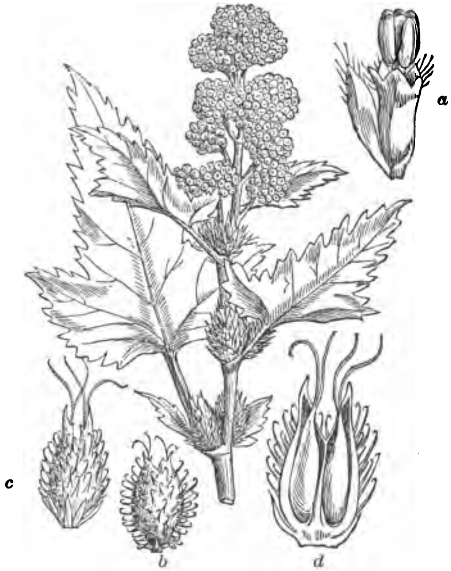

Fig. 4. Cocklebur (*Xanthium strumarium*). Showing staminate flowers above, pistillate below: *a*, staminate flower enlarged; *b*, head of pistillate flowers showing bur-like covering with hooked prickles and at top protruding styles; *c*, same, older; *d*, same, cut through lengthwise, showing the two achenia, each of which contains one seed.

There are two kinds of flowers in separate heads or clusters on the same plant, one having stamens, the other having pistils and producing seeds. The staminate or sterile flowers are in clusters near the top of the stem, the pistillate or fertile, with their seeds, below them. As already explained, plants of this family (*Compositœ*) have a row of scales around the head of flowers. In the fertile heads of this plant the scales take a peculiar form and become an egg-shaped bur, brown at maturity, covered with strong hooked prickles, and bearing two strong beaks at the upper end. This makes it very troublesome to sheep and to man also, because it adheres to the fleece or clothing.

Each bur encloses two flowers and at maturity, two seeds. It has been believed by farmers that one of the seeds may germinate the first year and the other lie dormant till a later time. Scientific investigation proves this to be true. Careful cultures of the seeds have been made at the University of Illinois, by Mr. G. W. McCluer, under the direction of Prof. T. J. Burrill. It was found that if a bur lies on the ground in such a position that one seed is up and the other down, the seed next to the soil may germinate and grow while the other lies dormant. This makes the plant somewhat difficult to deal with, for when apparently killed out, it may spring up again from these dormant seeds. But as the roots live only one year, it cannot withstand clean culture very long. It should never be allowed to seed.

This weed has been found by Baron F. von Mueller, of Australia, to be poisonous to cattle in that country. In the United States it is sometimes eaten sparingly by cattle with no serious results. Why it should be poisonous in one country and not in another is an unanswered question.

There are several parasitic fungi which grow upon the Cocklebur and draw their nourishment from its substance, thus helping to destroy it. These must be classed as beneficial fungi. Here are two of them. One appears in midsummer or later, as large brown blotches on the under surface of the leaves, and sometimes is so plentiful as to greatly reduce the plant's vitality. It is a "rust" known as *Puccinia Xanthii,* having the same general character as wheat rust; but it is a distinct kind. The brown blotches are entirely made up of spores, of which there are many thousands. The other parasite is a fungus which grows on the outside of the leaf instead of working in the interior as the rusts do. This may be called the Cocklebur Mildew. It grows over the leaf surface in the fall, giving the leaf a whitish or milky appearance. At length the spores develop, not bursting out from the interior of the leaf as the rust does, but forming in scattered brownish specks, just large enough to be seen among the white. Under the microscope they appear as balls, and contain spores. So fungi help us by preying upon weeds just as certainly as they injure our fruits and grains.

OX-EYE DAISY, WHITE DAISY, WHITE-WEED (*Leucanthemum vulgare*, Lam.)

The Ox-eye Daisy lives from year to year in the ground and spreads by means of short, creeping underground stems or root-stocks, penetrating a few inches in depth. The stems grow from one to two feet high and branch but little. When there are branches they come from near the base.

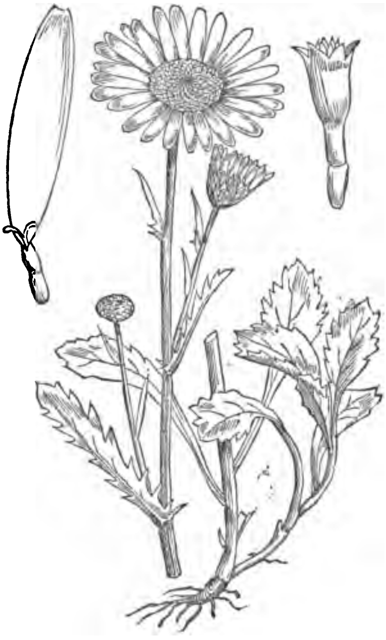

Fig. 5. Ox-Eye Daisy (*Leucanthemum vulgare*).

The root-leaves are spatulate, broadest near the apex, and have rather long leaf-stalks. Those on the stem have no leaf stalks. All are coarsely toothed or cut. There are scarcely any leaves on the upper part of the stem. At the end of the stem is one head of flowers, appearing like a single flower, and often called so, but really being composed of many small flowers, as already explained.

Those forming the row around the margin are white and each is spread out flat, so that it appears like only one petal of a flower; but it represents an entire flower. These are called the ray flowers. Each has its pistil (but no stamens) and produces one seed.

The central portion consists of many yellow, tube-shaped flowers, each of which has its stamens and pistil and produces a single seed.

The Ox-eye Daisy is very plentiful in the Eastern States. Grass lands are over-run with it so that at a distance they frequently appear as large white patches when it is in bloom. It is not a native plant but is introduced from Europe. In the Western States it has not yet become very troublesome, but is spreading every year. It was found in Wisconsin by the late Dr. I. A. Lapham of Milwaukee as early as 1859.

It is to be regreted that a plant so highly and so justly esteemed for the beauty of its flowers should become such a pest. It is a near relative of the cultivated kinds of *Chrysanthemum* and is scarcely exceeded in beauty by any of them. It is well worthy of cultivation for its flowers, if it can be kept from spreading too widely. It should not be allowed to mature its seeds.

To exterminate the Ox-eye Daisy from grass lands where it has got a hold is no small task, especially if it is generally diffused, unless there is a united effort on the part of all. A farmer finds little encouragement to clean it out from his own farm if he knows hundreds or thousands of seeds will be blown from his neighbor's farm or the roadside after a few weeks. It should never be allowed to seed; but keeping down the stems will not prevent the growth of the radical leaves, and so the roots and rootstocks will be nourished and live on indefinitely. To kill it out in grass lands is very difficult or impossible. Annual plowing or regular cultivation for some crop for several years is recommended and ought to be effective; but, unless the roadsides and fence corners are closely watched, all efforts will be thwarted by repeated seeding.

TOAD-FLAX. BUTTER-AND-EGGS. (*Linaria vulgaris*, Mill.)

This is the plant which is believed to be meant by the name of Snapdragon in the weed law, but that name belongs to a very distinct plant, *Antirrhinum majus*, L. Toad-Flax is called Snapdragon by some in this State but wrongly. It is said to have been introduced into this State as a garden flower, and it is not without beauty; but in becoming a weed it has fallen from popular esteem. It is frequently found in neglected yards, or escaped to the roadside, where it has taken a strong hold of the soil. Like most of our weeds, this is an introduced plant, an importation from Europe. It

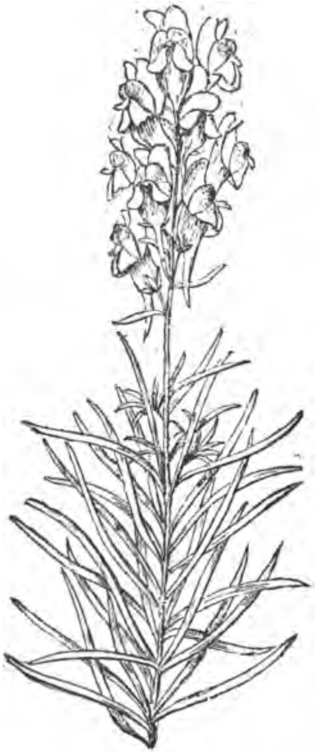

Fig. 6. Toad-Flax (*Linaria vulgaris*).

spreads widely by means of its running roots and is quite difficult to kill out.

The stem grows from one to (rarely) three feet high, and bears numerous narrow leaves like those of Flax, scattered along the stem without any apparent order. From this fact it takes the name of Toad-Flax. The flowers are produced in a rather dense cluster on the upper portion of the stem. They are yellow and two-lipped, with the lips pressed close together. At the base of each flower is a slender protrusion called the spur. This will always distinguish it from the Snapdragon, which has no spur but only a slight rounded swelling or bulging out of the tube of the flower in its place. The pods, when mature, open near the top by one or two small holes, which allow the seeds to escape. If a pod is examined, it will easily be seen to have a partition across the middle dividing it into two cavities, both of which are filled with many small seeds.

SNAPDRAGON (*Antirrhinum majus*, L.)

The true Snapdragon is closely related to Toad-Flax (*Linaria*), but still is a very distinct plant, and is not known to grow wild at all in Wisconsin, nor to be a weed in any sense. In no part of the United States has it more than sparingly escaped from gardens. It differs from Toad-Flax in its broader leaves and larger purple or white flowers, which have no spur at the base but only project slightly in a

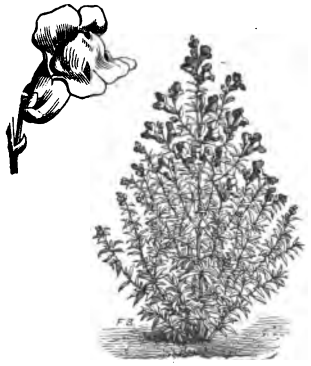

Fig. 7. Snapdragon (*Antirrhinum majus.*) Greatly reduced; one flower less reduced.

rounded form at the place where the spur would be if developed. It is highly esteemed as a garden flower.

COUCH-, QUITCH- OR QUACK-GRASS (*Triticum repens,* L.)

Couch-grass is a troublesome weed, not on account of its poor qualities as a grass, but of its aggressiveness. As an agricultural grass its qualities are excellent. In some parts of the country it is highly esteemed for cultivation and rightly. It compares well with Timothy in nutritive qualities, containing 9.94 per cent. of albuminoids, while Timothy contains only 8.3 per cent. It makes a good meadow.

But for the northern states its bad qualities overbalance its good ones. It produces long, slender underground stems which interweave, forming a strong sod. They send out rootlets at various points. These stems have joints like any common stem and from the joints branches are sent up which bear leaves and seeds. Usually branches do not come from every joint, but if the stems are broken or cut in pieces, as with a plow, hoe or harrow, each piece sends up a stem and leaves from any joint it may have and becomes a distinct plant. A large amount of nourishment is stored up in the form of starch, which makes the underground stems very nutritive and furnishes food for growth. The new plants formed by cutting up the old ones grow with great vigor and the result is many weeds in the place of one. When the subterranean portions are accessible to stock, they eat them readily. Horses and cows are fond of them and may get much nourishment from their rich stores. Hogs root industriously for them and give efficient help in extermination.

The mode of growth of this weed makes it very difficult to exterminate — quite like Canada Thistle. A summer fallow is highly recommended by those who have tried it. Turn the sod under in June and harrow whenever the grass appears above ground. Or sow with corn for fodder. This will help to keep down the grass. When once killed, it makes a rich manure as the Canada Thistle does.

In the structure of the " head " or fruiting portion, Conch-

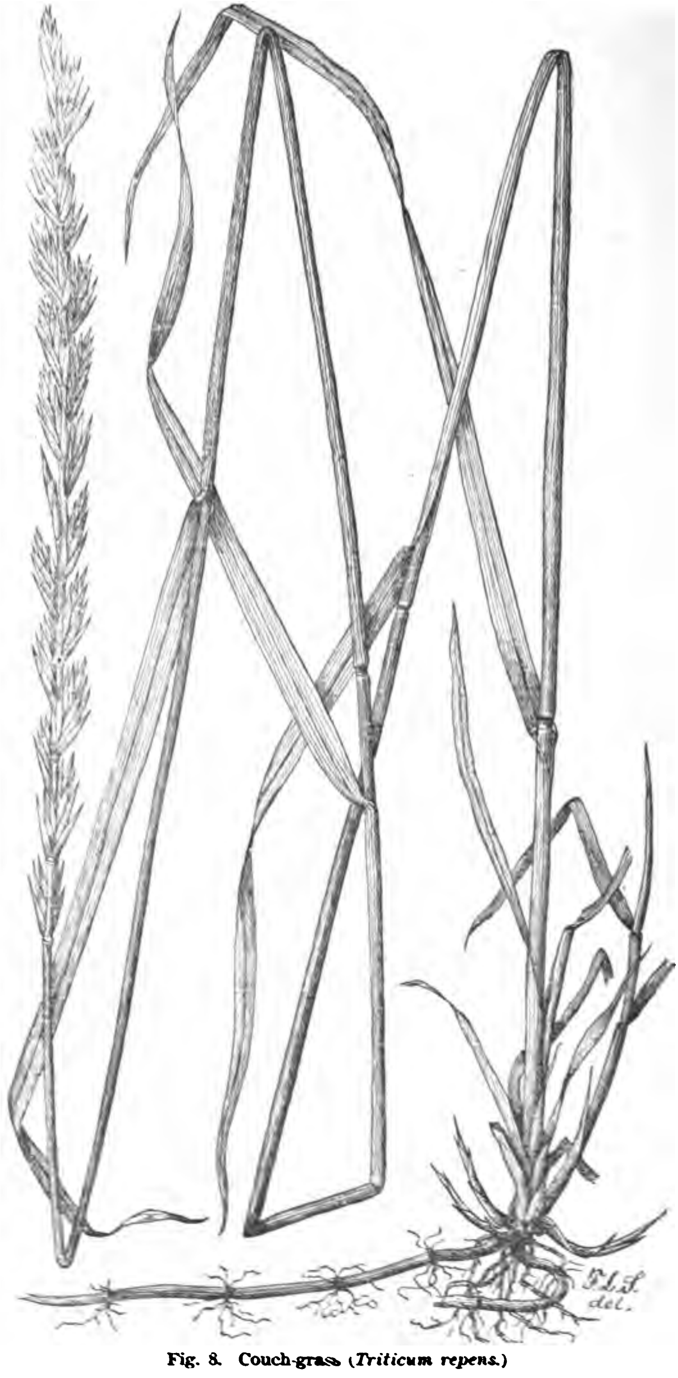

Fig. 8. Couch-grass (*Triticum repens.*)

grass is similar to wheat but smaller and the two are classed together by botanists.

One of the most valuable agricultural grasses in Montana is a close relative of Conch-grass and similar in its mode of growth. When a sod begins to be exhausted, it is renewed by harrowing. This breaks the underground stems into many pieces; each piece becomes an independent plant and grows vigorously.

BEGGAR'S LICE (*Cynoglossum Morisoni*, DC.)

During the late summer and fall the woods are full of plants of various species, whose fruit is provided with hooks, barbs, or some means of attachment to clothing or the hair of animals, which serves to disseminate the seeds. The worst of these is that named above. It grows two to four feet high and has long slender branches covered with the prickly seed vessels. The latter are covered with barbed points by which they adhere so tightly to clothing that they can scarcely be removed entire. It is a great pest and ought to be exterminated.

Thanks are due to the *Prairie Farmer* and Messrs. Currie Brothers of Milwaukee, for the generous loan of cuts, and to Prof. F. L. Scribner of the Department of Agriculture, Washington, D. C., for excellent drawings from which some of the cuts were made.

CORRESPONDENCE.

Mention has already been made of the correspondence of the Station. Below are given a number of inquiries addressed to the Station, with the replies which were made to them. These are printed here to illustrate the diversity of topics upon which information is asked and also because the subjects are of more or less general interest.

WHITEHALL, March 24, 1885.

PROF. HENRY, Madison Wis.

Dear Sir — I would like to know if White clover will make good pasture for hogs, and any information you can give in regard to it will be thankfully received. Want it to use up North where Red clover will not do well; they think White would grow there. Where can the seed be got and what will it cost, how much does it take to the acre, the method of sowing, and the benefit derived from it for hog pasture?

Address,
I. S. TULL,
Whitehall, Trempealeau Co., Wis.

In reply to yours of 24th, would say that it is hardly advisable to sow White clover alone on land for hog pasture. Better make a mixture of several grasses. Mix two bushels of Blue grass and one bushel of Orchard grass, one quarter bushel of Timothy and four pounds of White clover seed; sow this on three acres with a light seeding of oats or barley, or, better yet, without any grain at all. These grasses do not need any crop to shade them when starting as many farmers suppose.

Do not pasture until the sod is well formed; if grass runs up tall, cut for hay. No hogs should be turned on until the next season unless for a few weeks in the fall while the ground is dry. Remember that the thicker the seeding the better the result as a rule. A pasture with the mixture I have described should be worth one half more than where one grass only is sown.

Please report results. You can get the seed of J. C. Vaughan, 42 La Salle street, Chicago, or Albert Dickinson, Chicago.

W. A. HENRY.

COMMERCIAL FERTILIZERS — BRAN AND CORN MEAL FOR MAKING MANURE.

The following is from a letter received at the Station, written by a Wisconsin dairyman:

"Do you think that manure from cows is more valuable when they are fed on shorts and oil meal than when fed on corn and oats?"

A day or two after came one from an Iowa farmer with the following request:

"Will you please say in your judgment whether it will pay to use a fertilizer made of the offal of a large slaughter house, composed of bones, blood, liver, heads and feet, tanked; that is, all the grease taken out by a high degree of heat, dried and ground fine, at from $28 to $30 per ton. If so, how would you apply it to potatoes?" etc.

A reply was made through Hoard's *Dairyman*, May 21, 1886, as given below:

Answering the second question first I would say that the fertilizer, if it is as represented, is probably cheap enough at the figures named. Let us understand at once what is meant by the previous sentence. It is this: Nitrogen, phosphoric acid and potash, are each handled in such immense quantities in the manufacture of fertilizers, that they have come to have a commercial value that fluctuates scarcely more in price than sugar or tea does. The standard price at the present time in New York City for a pound of nitrogen in the substances used in preparing chemical fertilizers, is eighteen cents, phosphoric acid eight cents, and potash five cents. They are sold by the shipload at within the fraction of a cent of the figures given. Now the slaughter house offal named probably contained fully enough of these three chemicals to have a value of $30 per ton at the prices stated above for each constituent. The farmers of the little state of New Jersey alone, last year paid out over $1,000,000 for commercial fertilizers, and the trade is growing all the time. The conditions of the trade are such that except for certain grades of these commercial fertilizers, as slaughter refuse, the western farmer would have to pay a higher price than the eastern farmer, as the latter is nearer the source of supply. The price asked for the fertilizer was probably reasonable, but I doubt our Iowa farmer's being able to get the price of the fertilizer back and good wages in addition; that he must settle for himself.

Let us for the present leave the this part of subject and take up the first of the two inquiries, that of the relative value of the manure made by feeding dairy cows corn and oil meal. With the permission of the writer, I will compare corn with bran, as at present not much oil meal is used in the state, while the use of bran is very general. Let us first look at the question of how much nitrogen, phosphoric acid and potash we have in a ton of corn and bran. Fortunately we find these and many other stock foods arranged with just the facts we are after, in Prof. Stewart's work, "Feeding Animals," page 420. Here is a table of the three constituents we are studying, arranged for 1,000 pounds, not one ton, of the various feeds.

Amount of dry matter, nitrogen, potash and phosphoric acid in 1,000 *lbs. of each article named.*

	Dry matter.	Nitrogen.	Potash.	Phosphoric acid.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
Cotton-seed cake, decorated	900	66.0	15.0?	31.2
Cotton-seed cake, undecorated	885	39.0	20.1	22.9
Rape-cake	900	48.0	13.2	24.6
Linseed-cake	880	45.0	14.7	19.6
Linseed, flax-seed	905	36.0	12.3	15.4
Palm-meal	930	25.0	5.5	12.2
Linseed-meal, extracted	903	59.8	17.0	25.6
Poppy seed-cake	885	47.8	22.0	40.0
Hemp-seed cake	901	44.7	27.6	37.6
Walnut-cake	863	52.2	17.7	23.4
Sunflower-seed cake	897	55.9	26.8	35.4
Beans	855	41.0	12.0	11.6
Peas	857	36.0	9.9	8.8
Malt sprouts	995	38.0	19.5	17.2
Wheat bran	865	22.0	14.8	32.3
Oats	870	20.6	4.5	6.2
Wheat	856	18.8	5.4	8.0
Barley	860	17.0	4.9	7.3
Maize, Indian corn	886	16.6	3.6	6.1
Clover hay	840	19.7	19.5	5.6
Meadow hay	857	15.5	16.8	3.8
Bean straw	840	10.0	25.9	4.1
Wheat straw	857	4.8	5.8	2.6
Barley straw	850	5.0	9.7	2.0
Oat straw	830	5.0	10.4	2.5
Potatoes	250	3.4	5.6	1.8
Mangolds	115	1.9	3.9	0.7
Swedes	107	2.4	2.0	0.6
Carrots	142	1.6	3.2	1.0
Turnips	83	1.8	2.9	0.6

By the table we see there are 2 lbs. of nitrogen, 14.8 lbs. of potash and 32.3 lbs. of phosphoric acid in 1,000 lbs. of wheat bran, and 16.6 lbs. of nitrogen, 3.6 lbs. of potash, and 6.1 lbs. of phosphoric acid in 1,000 lbs. of corn meal. We see from this table that when we feed 1,000 lbs of bran we give our stock 5.4 pounds more nitrogen, over four times as much potash, and over five times as much phosphoric acid as when we fed 1,000 lbs. of corn meal. Now with milch cows we get back in the manure, solid and liquid, all but about 20 per cent. of these substances given in the food, according to the careful investigations of the German Experiment Stations. Let us figure then as to results, and see what 80 per cent. of the substances named above would be. Accordingly we find that the manure from 1,000 lbs. of corn meal when fed to milch cows, contains

Nitrogen, 13.2 lbs., at 18 cents, worth	$2.37
Potash, 2.8 lbs., at 5 cents, worth	0.14
Phosphoric acid, 4 8 lbs., at 8 cents, worth	0.38
Total	$2.89

Or $5.78 as the value of the manure from one ton of corn meal fed to milch cows. Now let us see what we would have from the bran. Taking 80 per cent. of the amounts named in the table we have as the manure from 1,000 lbs. of bran when fed to milch cows:

Nitrogen, 17.6 lbs., at 18 cents, worth	$3 16
Potash, 11.8 lbs., at 5 cents, worth	59
Phosphoric acid, 25.8 lbs., at 18 cents, worth	2 06
Total	$5 81

Or $11.62 as the value of the manure made from one ton of bran when fed to milch cows.

But says one: "That is as much as the bran costs, or more!" Very well so it may be and not affect the statement in the least. "Why don't the fertilizer companies buy bran and mix with their other materials?" May be they do, but probably not, for by the time bran gets to the eastern markets it is worth from $16 to $20 per ton. Another may say, "Why not use bran for manure?" but the answer may be made, "Why not feed it first and then use the 80 per cent. left for manure, thus getting two values from it. But says a third party "The manure from a ton of bran is not worth half of eleven dollars." That may be true, but are the farmers of New Jersey who last year paid out over $1,000,000 for fertilizers, foolish? Their land has been so reduced and fertilizers so scarce that they are forced to pay these prices in order to raise good crops.

Why should our Iowa friend pay $30 a ton for slaughter house waste, when he can buy three tons of bran with that money and feed it, and have left in the manure as great an amount of fertilizer as he would buy in the first place for the money.

It will be seen by the table that oil meal especially the extracted or 'new process" is still richer than bran in nitrogen, potash and phosphoric acid, so that the manure from it would be worth considerably more than eleven dollars per ton. With this table and the values given for the chemical constituents each can figure out for himself the value of the manure from the several articles.

It has been stated that the difference between the amount of nitrogen, etc. in the feed and in the manure, is about 20 per cent. with milch cows. With fattening animals the difference is much less. The cow uses the nitrogen and other substances to make milk from, while animals that lay on fat only, use scarcely any of these substances. The farmer who fattens grown animals may count on saving 95 per cent. of the manurial value of the food given. The dairy farmer who feeds the skim-milk on the farm and sells the butter only, does as well also.

But there is one very important point in this discussion. It has been taken for granted in this case that *all the manure is saved.* Let us look into this matter a little. Stewart tells us that with fattening oxen 73 per cent. of the nitrogen and 97 per cent. of the potash and phosphoric acid are voided in the urine. If we allow the urine to be wasted and save only the solids from our cows, we lose nearly all the value of the manure. What will Wisconsin farmers who bore holes in the drop back of the cows to let the urine through say to this? Or what will the large class who allow the manure to lie scattered about the barnyard and under the eaves of the barn have to offer against these figures. Do those farmers who doubt the value of manure from bran, shorts and oil meal, being any more than from corn or oats, really know from experience the worth of carefully saved manure?

Let those who believe this to be all scientific nonsense, first give the manure from one ton of bran a fair trial. Don't waste 97 per cent. of the potash and phosphoric acid and 73 per cent. of the nitrogen, and then cry "false."

What I have written may put this matter of the value of food for stock and manure, in a new light to some of our farmers I hope so, for it is time attention was called to the facts.

Train-loads of bran cross our state from the mills of Minnesota, to be fed on eastern farms. Let us be wise in our generation, and have this bran dropped on our Wisconsin farms, getting two values out of it. It can be done if we work intelligently and prudently. Minnesota, Dakota and Manitoba will grow poorer and poorer as they change the fertility of their soil into grain; while Wisconsin by feeding stock and making butter and cheese can grow wealthy, and our lands go up in fertility as our neighbors' are depleted. This may be a selfish view, but I suspect it is about as broad gauged as governs the world in most matters.

W. A. HENRY.

The following replies to enquiries appeared in the *Western Farmer,* February 13, 1886:

I. The artichoke is a variety of sunflower, having tuberous roots which are often recommended as valuable food for hogs. The tubers are planted somewhat like potatoes, and as the plant has perennial roots, it spreads, and the tall stems soon spread over the ground to the exclusion of other plants. In the fall or in the spring the hogs are allowed to root up and feed on the tubers. The whole thing looks simple, and as a thousand bushels of tubers to the acre have been reported, it would seem to be a profitable plant. No one seems to grow them, however, after a short time except the parties having the tubers to sell. The experiment usually ends in an unsightly patch of "wild sunflowers" that the farmer wishes out of the way.

II. The Ramie plant is most valuable for producing fibre of fine quality, but it will not survive Wisconsin winters. It has been grown two seasons at the Experiment Station, each time producing plants almost three feet high, resembling the nettle—which it is—but the roots were dead by spring. It may succeed in some of the southern states or California.

III. Sainfoin, or Esparsette, is a legume or member of the pea family, and so related to alfalfa and the clovers. It is grown in Europe and Great Britain, and in localities is highly esteemed for the hay produced. One writer in the Journal of the Royal Agricultural Society reports two tons of hay and twenty bushels of seed per acre in one year from this plant. It requires a limestone soil and several years to establish itself. When tried in this country it has not succeeded. We will try it at the Station, however.

W. A. HENRY.

How and what to feed is a problem ever present with the farmer. With lower prices for everything and the cost of raising hay and grain remaining about as in the past, we must use all the light we have and get the very best returns for all feed given.

The following letter bears upon this point:

LAKE MILLS, March 9, 1886.

PROF. HENRY, DEAR SIR—I am greatly puzzled over the results I am getting from my cows. I will give you the results from one of my cows and the variation in her milk will apply to my whole herd of forty cows.

After she "came in" there was a gradual increase in her milk for about two weeks, when she gave 42 lbs. per day. For a week she gave about the same amount, and then there was a gradual decrease for about two weeks when she gave 23 lbs. per day, and there she stays and no amount of feed will bring her back to to her former yield.

I feed my cows in the morning three quarts dry meal and a small ration of Timothy hay. Noon, cut corn-stalks and three quarts meal, stalks thoroughly wet, the meal mixed with the stalks. Night, the same feed as at noon. My meal consists of ⅓ ground corn, ⅔ ground barley screenings.

Is there anything in the feed I am giving them that should make them act so? The cows look well, feel well and grow fat. Most of them are half and quarter grade Ayrshire.

Please excuse me for troubling you with this matter; it is a question of great importance to us.

Respectfully yours,

C. T. FARGO.

The reply through Hoard's *Dairyman* was as follows:

The ration as stated by Mr. Fargo is faulty in being very rich in carb-hydrates or fat-producing food and poor in protein or cheese-making material. A cow cannot vary the proportion of fat and cheese in her milk to any great extent and though given plenty of food for fat,.in this case the cows have to reduce the milk flow to suit the limited amount of protein in the ration. The extra fat is put away in the body or wasted in the excrement. Such seems to be the case. Now let Mr. Fargo withdraw some of his carbonaceous food and substitute a material rich in protein and carefully note the results. If he has oil meal on hand substitute some for part of the grain mixture he is giving. In this case the meal is fed, not for the oil or starch in the large amount of nitrogen in the form of protein. If possible, feed three or four pounds of oil meal daily to a few cows; to other cows give six pounds of bran instead of the oil meal; and to others still say five pounds of bran daily and substitute good Clover hay for the Timothy hay. By weighing the food once he can estimate by measure after that the amount to feed. With such a herd as Mr. Fargo has it is well worth his time to study the case carefully, not only for the results this season but in coming years; If bran, shorts and oil meal for grain ration and clover hay for roughness are used in part, in this case Mr. Fargo may look for better results than he is now getting. Yet it must be remembered that the cows are down in their milk and have started to grow fat; to counteract these tendencies and set them on the right road again may be out of the possibilities at this date. I think Mr. Fargo will see the bearing of what I have tried to explain and will make a careful study of his herd, and not only change the feed as indicated but carefully note the results, writing them up for the *Dairyman* so that thousands can get the results of his experience. It is just these cases that interest every man who has a cow to feed and is trying to get her to do her best. I shall look for the results with great interest.

W. A. HENRY.

LAND PLASTER.

The following correspondence regarding the action of land plaster, originally printed in the *Western Farmer,* will be of interest in connection with the analyses of this article reported on previous pages:

A correspondent asks for information regarding the action of land plaster on the soil.

Land plaster does not take anything from the air; its action is wholly on the soil. It contains lime and sulphuric acid, both of which are essential to the growth of plants, and in so far as the soil is deficient in these substances it acts directly as plant food. Usually, however, these substances are present in at least fairly sufficient quantity, and then the action of plaster is an indirect one. It has the power of acting upon other ingredients of the soil, particularly potash, and dissolving them, thus rendering them available to the plant. In this way, a manuring with plaster may be equivalent to manuring with potash, so far as the immediate effect is concerned. Such treatment, if continued, however, must gradually reduce the store of potash and other substances in the soil and thus lead to its impoverishment. With a rich soil this effect would be slow in showing itself, but on a soil having only a limited store of plant food it might show itself in a short time.

H. P. ARMSBY.

MESSRS. EDITORS — In *Farmer* of February 20, is an answer by Prof. Armsby to a question of a correspondent in regard to the action of land plaster, in which the Professor says that plaster "does not take anything from the air;" its action is wholly on the soil. Now I wish to ask the Professor, Is this a *demonstrated* fact in science, or is he only giving an *opinion* of a certain school of which Sir Humphrey Davy may be considered as at the head? It is well known that Liebig held to the idea that the value of its action was chiefly in its fixing the ammonia of the atmosphere and conveying it to the roots of plants.

Again will the Professor tell me what chemical, change takes place, or how does he account for the fact that when there is a strong scent of ammonia arising from the horse stable, the dusting of the stable with ground plaster allays that scent?

Respectfully,

J. C. BRAINERD.

Danville, Wisconsin

REPLY:— It is "a demonstrated fact in science" that the soil itself, without any addition of plaster, is abundantly capable of fixing the ammonia of the atmosphere, whether that conveyed to the soil in gaseous form by the atmosphere itself or that dissolved out of the air by the rain and thus carried into the soil. It is theoretically possible that plaster should fix the ammonia of the air; but, since the soil can also do this, the secret of the action of plaster must be sought elsewhere.

The amount of ammonia which the soil can receive from the air is apt to be overestimated. The proportion of ammonia in the atmosphere is variable, but may be put down roughly at one part in fifty millions. To render these numbers more comprehensible, we may compute that the air over an acre to the height of 750 feet would contain ammonia enough to make about an ounce of dry clover seed.

Rain water contains from 1 to 30 or more parts of ammonia in ten million parts by weight. The quantity of ammonia carried into the soil in the rain during a year is estimated by Lawes, Gilbert & Warrington, in their latest publication, at about 2¼ pounds per acre per year. These small quantities of ammonia the soil is abundantly able to take care of without the aid of plaster.

Furthermore, the crops on which plaster produces the most effect are precisely those which fail to repond to a manuring with ammoniacal compounds, but which do respond to potash.

The action of plaster in retaining ammonia in manure is a somewhat different matter, because there the ammonia already exists in the substance and the plaster simply prevents its passing into the atmosphere. Land plaster is sulphate of lime, a compound of sulphuric acid and lime. The ammonia of manure is combined with carbonic acid to form carbonate of ammonia (smelling salts) which assumes the gaseous form very readily. Now, when these two compounds are brought together *in the presence of water* a chemical change takes place. The lime unites with the sulphuric acid to form sulphate of ammonia, which is not volatile and therefore does not escape.

This reaction takes place only in the presence of water, and if the resulting mixture be dried, the reverse action takes place and the ammonia escapes again as carbonate.

H. P. ARMSBY.

Eds. Western Farmer: Prof. Armsby's reply to J. E. Brainerd's inquiry about the escaping of ammonia from decaying vegetable substances calls for further inquiry.

1. Will the professor please inform us if a mass of hay or straw, becoming wet, and being exposed to the atmosphere and thereby becoming oxydized and in time soured — if that is not the commencement of the formation of ammonia in that wet straw.

2. Now if that straw becomes dry by the sun shining upon it and the wind blowing over it, does not that drying pile lose the ammonia thus generated by being evaporated and blown away? Is that pile of straw as rich in ammoniacal substances as it was before being wet and then dried?

3. If, after a hard rain and consequent wetting of the vegetable substances upon the soil and in the soil all over the land, and thus evaporated, would not a great amount of ammonia escape in the atmosphere?

4. If the cooling of the atmosphere will cause the dews to become condensed and fall to the ground in the night, would not the floating ammonia also be condensed and brought down?

5. Would not plaster or gypsum, or the sulphuric acid of the gypsum, having affinity for the ammonia, attract it, and cause the land to more readily absorb the ammonia?

6. If gypsum thrown upon the floor of the stables will arrest the ammonia escaping in the stable, would not the gypsum thrown upon the land have the same effect, to *fix* the ammonia in the land and make it available for plant food?

7. How is it possible, upon sandy lands, where there is very little potash in the land, and no lime or certainly very little, carbonate of ammonia can be found sufficient to produce good crops of clover?

8. Why is it, when manure is spread upon the surface of the land, and gypsum is sown or is strong in the land from previous sowing, that manure can be most effectually saved, unless it is absorbed by the land, and much more thoroughly than it could be without the aid of gypsum, (a fact in my own experience)?

Now, Prof. Armsby, do you suppose Gilbert, Warrington and Lawes succeeded in capturing *all* of the ammonia over one acre of land in a year and secured only two and one-half pounds? Plainly, professor, do you not suppose if they could capture all the ammonia from *two square yards* of fully grown clover that was left to decay, or became wet and then dried several times until all the ammonia was dried out of that clover, thus decaying and wasting, and floating in the atmosphere, it would be fully as much as two and one-half pounds? These are important facts we want light upon. Experience is a good teacher, and sometimes goes farther in demonstrating facts than scientific theories.

N. E. ALLEN,

Beaver Dam.

REPLY—Other occupations have prevented an earlier reply to Mr. Allen's communication. I will take up his questions in their order. It may conduce to a clearer understanding of some of the following paragraphs to say that ammonia is a compound of the elements nitrogen and hydrogen, containing in 100 parts, 82.35 parts of nitrogen and 17.65 parts of hydrogen.

1. Yes. Wet vegetable matter, whether fully exposed to the atmosphere or not, begins to undergo that series of changes called collectively decay. Speaking of the decay of vegetable matter, Prof. S. W. Johnson (How crops feed, p. 138) says, "The nitrogen of the vegetable matter is to a large extent liberated in the gaseous state; a portion of it unites to hydrogen, forming ammonia, which remains in the decaying matter; still another portion remains in the humus in combination, not as ammonia, but as an ingredient of the ill-defined acid bodies which constitute the bulk of humus; finally, some of the nitrogen may be oxidized to nitric acid."

2. No, the pile will not lose ammonia to any great extent, because the humus formed by the decay of the large amount of woody fiber and starchy matter contained in vegetation has the power of absorbing and uniting with the ammonia and so preventing its loss. When animal matters, which consist chiefly of ammonia-yielding substances, decay, there is almost always a considerable loss of ammonia, but only in very exceptional cases is there any notable loss of ammonia from decaying vegetable matter.

3. No. Not only has the decaying vegetable matter in the soil the power of absorbing and holding ammonia, as just explained, but the

mineral matters of the soil have also this power to a certain extent. For example: Lawes, Gilbert & Pugh have experimented upon the decay of wheat, barley and beans, both whole and ground, mixed with a large quantity of soil or powdered pumice stone and exposed in various conditions of moisture to a current of air for six months. They found that from 11 to 58 per cent. of the nitrogen present was converted into ammonia, but that on the average only 0.4 per cent. escaped in the gaseous state, the rest being retained by the soil.

4. Yes.

5. The soil without plaster absorbs ammonia so readily that it is difficult to see how a dressing of say 100 pounds of plaster to the acre, amounting to about one one-hundredth of one per cent. of the weight of the soil to the depth of 3 inches, could materially aid it.

6. Doubtless it would, were there any occasion for its action, but, as already explained, the humus of the soil suffices to hold the ammonia. Moist peat, which is virtually humus, or even rich soil, spread over the stable floor would also absorb the ammonia. It would be necessary to use more of these absorbents than of the plaster, of course, but they are also present in the soil in vastly greater proportion.

7. The most convincing proof of its possibility is to be found in the fact that good crops of clover can be produced on light, sandy soils. It does not take a very large percentage of potash or lime or ammonia to make enough pounds per acre, down to the depth to which clover roots penetrate in light soils, to produce a large crop. Three tons of clover hay would contain about one hundred and ten pounds of potash. If we assume this amount of clover to be produced on an acre and assume further that all its potash comes from the upper twelve inches of the soil, which is far from being true, clover being a deep rooting plant, especially in light soils, we find that six one-hundredths of one per cent. of available potash in the soil would suffice for twenty such crops. Very nearly the same relation holds good for the ammonia and lime.

8. Presumably, the plaster acts upon the manure in much the same way that it does upon the soil, its lime being absorbed and a corresponding amount of potash and other bases being rendered soluble.

Now, Mr. Allen, if you will turn to my article, you will see that I do not assert that Lawes, Gilbert and Warrington captured "all the ammonia over an acre of land in a year and secured only two and one-half pounds." My statement was that the total rain and snow falling upon an acre in a year contained two and one-half pounds of ammonia. The reputation of these experimenters for care and accuracy is too high to allow any doubt as to the substantial accuracy of their results. In addition, they found in rain and snow about one pound per acre per year of nitrogen in the form of nitric acid and about as much in the form of organic matter (dust, etc.), making altogether about four and one-half pounds of nitrogen per acre per year.

I do *not* suppose that all the ammonia from two square yards of fully grown clover would be fully as much as two and one-half pounds. Let us reason together. Three and one-half tons of clover hay per acre may certainly be considered as at least a good crop. One acre contains 4,840 square yards. At the rate of 3½ tons per acre, two square yards would yield the material for a little less than three pounds of hay.

Plainly, Mr. Allen, do you suppose that it is possible, by any sort of legerdemain, to get over 2½ lbs. of ammonia out of 3 lbs. of clover hay which contains by analysis enough ammonia-forming material to produce at most three pounds of ammonia per hundred pounds of hay? If it is, this also is an important fact which we want light upon.

Finally, Mr. Allen, allow me one question in my turn. Experience is undoubtedly a good teacher, and "scientific theories" go no distance at all in demonstrating facts. But who do you think is likely to know the most about the facts regarding the ammonia supply of plants and the loss of ammonia from the soil, the man who makes it his daily business to find out all he can about these same facts, and to keep informed as to what other students of the subject have found out, or the man of equal mental capacity who considers these questions only in the intervals of a laborious occupation? Should not the *experience* of the scientific man, drawn from wide and careful study and experiment, be held in at least equal esteem so far as it extends with the *experience* of the practical farmer?

H. P. ARMSBY.

HEN MANURE AND ASHES.

Please write me how best to apply hen manure and unleached ashes and to what garden produce or fruit it will add most in value.

GEO. J. KELLOGG, Janesville.

REPLY—They ought not to be mixed together for any length of time previous to applying them, for the potash of the ashes will set free the ammonia of the hen manure. They might, however, be applied together if desired, as no loss of ammonia is to be feared when they are thoroughly mixed with the soil. Hen manure is valuable chiefly for its ammonia and phosphoric acid; ashes chiefly for their potash and lime. The two together would make a complete manure. I should think it would be advisable to use them in the hill or row a short time before planting, rather than to broadcast them. They should be well mixed with the soil so that the roots of the young plants may not come in contact with the unmixed manure. I doubt if it makes much difference what crop they are applied to. The ashes, however, might prove of value on small fruits, as the latter contain considerable potash.

H. P. ARMSBY,

The following was written to Mr. Paul Lachmund, of Sauk City, concerning two samples of soil sent by him for analysis:

Such an analysis would be of no service to you, because there is no way known of finding out how much of the plant food found by analysis is in such a condition that a crop can use it. Analysis of soils, to be of any benefit to the farmers of the state, must be undertaken on a systematic plan and made on a large number of samples. We have had such an investigation in view for some time, but are not yet in condition to undertake it. Analyses of single small samples are practically useless.

H. P. ARMSBY.

FERTILIZERS FOR TOBACCO.

I beg leave to submit to you the following questions and to request your kind reply thereto if not greatly interfering with your other duties and labors:

1. What composition of artificial fertilizers is best adapted for a light sandy loam if devoted to the culture of tobacco?

2. Is it advisable to use privy manure for the same purpose on the same soil?

The land I intend to plant to tobacco is now seeded down to clover and timothy, but has been somewhat neglected as to manure. I can supply about eight to ten loads of stable manure to the acre, therefore, query,

3. What amount of artificial manure will it require per acre to insure a fair growth of tobacco?

4. Have artificial manures been tried in the tobacco growing districts of this state, and do you know with what success?

Hoping to hear from you, I remain,

Yours respectfully,

Sauk City, Wisconsin. PAUL LACHMUND,

REPLY — In the present state of our knowledge it is not possible to say with any great certainty what composition a fertilizer should have to adapt it to tobacco, or to any particular crop.

Potash is contained in large quantities in the tobacco plant, and on general principles should be supplied liberally in the manure.

Privy manure is not suited to tobacco. It contains a large quantity of salt which tends to injure the burning qualities of the leaf.

I cannot tell you how much fertilizer to use per acre, for I do not know how rich the stable manure you propose to use is, nor how much fertility is already in the land. In general, tobacco requires a very fertile soil in a very mellow condition. It should be as rich and in as good condition as a good garden soil. Unless your land will give you as much as sixty bushels of shelled corn per acre it would hardly be advisable to try to raise tobacco on it, and in any case it would be better to let tobacco follow a hoed crop than grass. In short you should have your soil well enriched from previous treatment and not depend too much on the use of manure directly with the tobacco.

I do not think that artificial manures have been used on tobacco in this state to any extent. They are successfully used in the east and south.

H. P. ARMSBY.

I wish to ascertain whether I can obtain an analysis of a tobacco leaf with a view to ascertaining for the benefit of this association the different ingredients which go to make a perfect leaf, so that our farmers may know what fertilizers to apply to procure the best results. I would also like to find the composition of what we call "trash," my belief being that it is worth more to the farmer if put back on the land as a fertilizer than if sold at a cent per pound as it now is. Would there be any expense attached to such analysis?

Very Respecfully,
A. M. VALENTINE.
Secretary Northwestern Leaf Tobacco Growers' and Dealers' Association.

REPLY — The Station can analyse a sample of tobacco leaf for you if you desire and there would be no charge for it. It would hardly be necessary for your purpose, however, as there are already numerous such analyses on record showing sufficiently well the composition of the leaf. I copy below Wolff's average of German analyses and also the average of six analyses of leaf tobacco recently made at the Connecticut Agricultural Experiment Station (Annual Report, 1884, p. 100). Only the ash ingredients are given, as these are the ones which must be supplied through the soil.

Principal Ash Ingredients of Leaf Tobacco.

	German Analyses.	*American Analyses.*
Sand, Silica and soil	1.85 per cent.	2.98 per cent.
Oxide of iron, and alumina		0.17 per cent.
Lime	6.28 per cent.	5.59 per cent.
Magnesia	1.77 per cent.	1.95 per cent.
Potash	3.03 per cent.	5.71 per cent.
Soda	0.51 per cent.	0.09 per cent.
Phosphoric acid	0.48 per cent.	0.63 per cent.
Sulphuric acid	0.58 per cent.	1.16 per cent.

You will see that both these averages show *lime* and *potash* to be the prominent constituents of the ash and indicate that these substances in particular might be supplied in the manure to advantage. This indication is, I believe, confirmed by the experience of those growers who have used fertilizers on tobacco.

It is advisable, however, to exercise care in the choice of materials for fertilizers. Any large amount of *chlorine* in a manure is very liable to injure the burning qualities of the leaf. Lime would be best applied either as sulphate (plaster), carbonate (air-slaked lime or leached wood-ashes) or hydrate (slaked lime); potash as high-grade sulphate or in wood-ashes. So-called "muriate of potash," which contains about 45 per cent. of chlorine, and fertilizers containing it should be avoided. A moderate amount of nitrogenous fertilizer would probably increase the gross yield, and if used cautiously would not be likely to injure the quality.

"Trash," I suppose to mean chiefly the stalks after stripping. A recent analysis of these, also by the Connecticut Station, gives them a value of not over $10.50 per ton in the condition in which they usually are at the time of stripping. If they became drier, a ton of the dried stalks would, of course, be worth more.

H. P. ARMSBY.

Referring to the above reply, Mr. Valentine wrote as follows:

If the Connecticut analysis was of ash from leaf grown from Spanish seed, it is sufficient, but if grown from the old "broad leaf" would it be of any value to the Wisconsin grower of Spanish?

* * * * * * * * * *

Horse manure is regarded as the fertilizer containing the ingredients best calculated to produce the desired results. But it is getting to be exceedingly difficult to procure it in sufficient quanity and a substitute is necessary. What shall that substitute be? It must contain an abundance of ammonia to form a quick growth. We are recommended to use castor pomace — the refuse of the castor bean when ground for oil. Can you give me any information about it?

* * * * * * * * * *

A. W. VALENTINE.

REPLY.— The selection of fertilizers for tobacco is a matter for experience rather than chemical analysis to decide. An analysis of the leaf can only show in a *general way* what ingredients are required for growth, and hence I think the Connecticut and German analyses are sufficient for the purpose.

I understand that castor pomace is considered a good fertilizer for tobacco by those who have used it.

* * * * * * * * * *

H. P. ARMSBY.

METEOROLOGICAL OBSERVATIONS.

FURNISHED BY THE WASHBURN OBSERVATORY.

In its annual report for 1884, this Station published a "Summary of meteorological observations taken at Madison during the period 1853–1884," prepared by the Washburn Observatory. By the courtesy of the same institution we are enabled to present in this report a summary of the observations of the year 1885, taken from its volume of "Publications," and also two tables giving summaries by years and by months for the period 1853–1885. These two tables correspond to tables II and III of the Station report for 1884, but have been corrected and brought up to the close of 1885.

METEOROLOGICAL OBSERVATIONS FOR THE YEAR 1885

Month.	Observations Taken at 7 A. M., 2 P. M., and 9 P. M. Means Refer to Day Ending 12 P. M.			For 24 Hours Ending 9. P. M.			For 24 Hours Ending 2 P. M.	
	Mean monthly barometer.	Mean monthly temperature.	Mean relative humidity.	Rain or melted snow.	Maximum temperature.	Minimum temperature.	Maximum velocity of the wind.	Total movement of the wind.
	Inches.	°	*Per cent*	*Inches.*	°	°	*Miles.*	*Miles.*
January ...	29.045	7.0	76.3	2.44	40	—25	36	8,042
February...	28.940	8.2	85.0	0.82	40	—22	36	5,699
March	29.007	24.9	74.3	0.62	54	— 5	45	9,488
April	28.977	42.0	77.7	3.45	74	21	40	9,099
May	28.898	54.8	63.7	1.68	84	27	42	7.955
June	28.987	65.2	72.8	5.11	84	42	45	7,945
July	28.941	75.2	76.4	7.30	90	52	72	7,152
August	28.967	64.2	78.0	6.41	82	46	36	6,980
September .	28.996	59.9	76.1	4.05	79	42	32	7,444
October	28.972	44.8	77.2	2.37	71	26	40	8,339
November .	28.924	35.6	84.7	2.74	55	22	36	7,071
December .	28.979	23.7	87.3	3.59	51	—13	60	8,822
Sums	....	....	....	40.58	......	......	......	93,126
Means	28.969	42.1	77.5	....	......	......	......	......

Highest barometer, 29.580 inches; lowest, 28.146 inches. Highest temperature, 90°; lowest, —25°. Range of barometer, 1.434 inches. Range of thermometer, 115°. Maximum velocity of wind, 72 miles from N. W. Prevailing winds, N. W. and S. Number of clear days, 118; fair days, 153; cloudy days, 94. Number of times the wind blew from the N., 147; N. E., 61; E., 48; S. E., 78; S., 231; S. W., 162; W., 123; N. W., 233. (Three observations daily.)

TABLE II.—SUMMARY OF METEOROLOGICAL OBSERVATIONS FROM 1869 TO 1885, INCLUSIVE, BY YEARS.

N. B.—See remarks at end of the table.

YEAR.	Mean yearly barometer. (Inches.)	Mean yearly temperature.	Highest temperature of the year.	Lowest temperature of the year.	Range of temperature for the year	Rain or melted snow. (Inches.)	Mean relative humidity. Per cent.	No. days on which rain or snow fell.	Prevailing wind.	Maximum velocity of wind. (Miles per hour)	Year'y movement of wind (Miles.)
1869	28.966	42.9	89	—11	100	43.27	79.2	103	N. W.	45	....
1870	28.920	47.2	98	—13	111	27.82	69.5	93	N. W.	35	....
1871	28.903	46.1	91	—15	106	29.51	70.7	103	W.	35	....
1872	28.897	44.4	92	—28	120	22.44	73.9	87	S. W. N. W.	35	....
1873	28.893	43.8	91	—21	112	26.49	76.5	80	N. W. S. W.	35	....
1874	28.950	45.5	96	—15	111	29.02	74.1	85	S. W.	35	....
1875	28.917	42.4	86	—25	111	22.59	74.2	100	W. S. W.	25	....
1876	28.921	46.1	90	—22	112	36.04	78.3	93	N. W. S. W.	35	....
1877	....	47.7	88	—16	104	27.67	77.3	84	S. W.	25	....
1878	....	49.7	92	— 9	101	39.54	71.7	104	N. W.	50	[23,132]
1879	28.998	47.9	91	—22	113	35.10	68.7	108	S.	48	87,425
1880	29.989	48.1	93	—21	114	46.72	70.0	138	S. W.	50	90,855
1881	29.001	46.9	95	—20	115	52.92	72.4	158	N. W. S.	45	84,342
1882	29.005	47.1	87	—13	100	42.89	75.3	160	N. W. W.	48	85,448
1883	29,006	42.3	89	—23	112	39.84	77.9	121	N. W. S.	60	[60,188]
1884	28,992	43.4	86	—27	113	49.19	77.8	144	S.	78	93,983
1885	28.969	42.1	90	—25	115	40.58	77.2	144	N. W.	72	93,126
Means.	28.955	45.5	90.0	—21.6	111.6	35.98	74.4	114	....	57.3	89,196

REMARKS—For 1878 the maximum velocity of the wind and the No. of miles traveled were observed for October, November, December only.

For 1883, the same data are for 233 days only; the maximum and minimum thermometer and Range of Temperature for 323 days. The other data for 328 days.

The mean barometer, temperature, rainfall, humidity, No. of days on which snow or rain fell, are given from all the data, 1869–1885. The *mean*, highest and lowest temperature, the range, and the maximum velocity and number of miles traveled by the wind, relate only to the years 1879–1885.

TABLE III—SUMMARY OF THE PRECEDING METEOROLOGICAL OBSERVATIONS BY MONTHS.

Month.	Mean monthly barometer (inches). 1853-1885	Mean monthly temperature. 1853-1885.	Mean maximum temperature. 1879-1885.	Mean minimum temperature. 1879-1885.	Mean monthly range of temperature. 1879-1885	Mean monthly fall of rain or melted snow (inches) 1853-1885.	Mean relative humidity (per cent). 1855-1885.	Mean number of days on which rain or snow fell. 1853-1885.	Mean direction of wind 1853-1885.	Mean maximum velocity of wind (miles per hour). 1879-1885.	Mean monthly movement of the wind (miles). 1879-1885.
January	29.009	18.0	43.4	−17.0	60.4	1.69	81.3	8.6	S. W.	33.0	7,663
February	28.990	21.5	47.9	− 9.1	57.0	1.65	81.1	7.5	N. W.	34.1	7,539
March	28.920	30.7	57.9	+1.7	56.2	2.05	72.3	8.0	N. W.	39.4	8,820
April	28.921	44.4	76.9	19.0	57.9	2.41	67.0	8.7	S.	41.0	8,364
May	28.928	57.9	83.0	40.5	42.5	3.68	64.2	10.0	S., N. E	34.3	7,461
June	28.918	67.1	86.4	45.6	40.8	4.79	70.3	10.1	S. W.	39.5	6,319
July	28.970	72.5	89.5	52.9	36.7	4.55	69.0	8.6	S. W.	43.5	5,915
August	28.988	69.6	88.1	49.4	38.7	3.41	70.1	8.4	S.	35.6	6,049
September	29.004	61.3	83.4	41.9	41.5	3.43	70.7	8.1	S.	35.7	6,843
October	28.988	48.4	77.3	27.3	50.0	3.08	71.8	8.2	S.	40.2	7,973
November	28.965	33.7	60.9	8.8	52.1	2.14	77.7	8.1	N. W.	35.2	8,121
December	29.003	22.4	46.2	−11.6	57.8	1.87	81.1	9.4	N. W.	38.6	7,967
Means	28.969	45.6	......	......	49.3	2.90	73.9	8.6	S.	37.5	7,420
Sums	......	......	......	......	......	34.75	......	103.7	......	......	89,034

ACKNOWLEDGEMENTS.

The Station will be glad to receive and place among its exhibits, any article of agricultural interest, making due acknowledgement therefor in its annual report, and such acknowledgement and exhibition will be considered as fully discharging the obligations of the Station to the donors.

In case of articles which appear of sufficient general interest to merit it, appropriate tests will be instituted, provided the other work of the Station will permit, and the results of such tests published for the information of the farmers of the state. In no case, however, will the Station recommend and endorse any such article otherwise than, as above stated, by publishing the results of actual tests.

The following articles were donated during the year 1885:

One Ton Oil Meal—St. Paul Linseed Oil Co., St. Paul, Minn.

One No. 8 *Diamond Feed Grinder*—McLaughlin & Sheldon, Owatonna, Minn. A partial report of trials with this machine is given on page 75.

A short notice of the Gilt-edge Butter Worker was prepared for insertion at the proper place, but the copy was overlooked by the printer. Space here will only permit the statement that with a little practice in manipulation this has proved a satisfactory machine for the purpose intended.

Butter Worker—Racine Refrigerator Co., Racine, Wis.

Concave-curved Potato Knife—Humphrey Bros., Wakeman, Ohio.

Seed Corn—Three samples. W. H. Swartz, Byron, Minn.

Seed Oats—Three varieties; *seed potatoes*, two varieties, F. A. Huebner, Manitowoc, Wis.

Grass Roots—Two varieties, Chas. W. Eley, Smith's Point, Texas.

Millo-Maize—Seed from G. W. Benson, Marietta, Ga.

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